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VOLUME 11

1930

PUBLISHERS

AMERICAN MEDICAL ASSOCIATION

CHICAGO

Medical
A.M.A.

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JANUARY, 1930

PUBLISHED MONTHLY BY AMERICAN MEDICAL ASSOCIATION, 535 NORTH DEARBORN STREET, CHICAGO, ILLINOIS. ANNUAL SUBSCRIPTION, $6.00

Entered as Second-Class Matter, January 14, 1925, at the Postoffice at Chicago, Illinois, Under the Act of March 3, 1879. Acceptance for mailing at special rate provided for in Section 1103, Act of October 3, 1917, authorized January 22, 1925.

NOTICE

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ARCHIVES OF OTOLARYNGOLOGY

VOLUME 11 JANUARY, 1930 NUMBER 1

OTOSCLEROSIS IN ITS HISTOGENIC RELATIONS TO OSTEODYSTROPHIA FIBROSA (OSTITIS FIBROSA) *

MORITZ WEBER, M.D.
SAN FRANCISCO

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The relations between otosclerosis and osteodystrophia fibrosa have received considerable attention in the literature from both the clinical and anatomic standpoints. However, to my knowledge, no special critical comparison of these two diseases from the standpoint of histogenesis has appeared considering the most recent contributions made to the pathology of osteodystrophia fibrosa. Therefore a study in this direction seems advisable.

O. Mayer said, in 1928: "Another disease of bone, however—the osteitis deformans of Paget—has a connection with otosclerosis. Even

* Submitted for publication, Aug. 13, 1929.

* From the George Williams Hooper Foundation for Medical Research, University of California.

* This study was aided by grants from the John C. and Edward Coleman Memorial Fund.

during my earliest investigations of otosclerosis I was struck with the similarity of this condition to that found in osteitis deformans." He stated further that the original bone in both diseases is replaced by newly formed bone, and that this process may lead to an ankylosis of the stapes. "The difference, however, consists in the fact that in Paget's disease the lesion is not restricted to localized areas, but is diffuse, and further, that the new-formed bone is better developed; still, I have been impressed by the fact that in some instances of Paget's disease there were localized lesions similar to those found in otosclerosis." He continued that in the cases observed by him in which both diseases were present it may be attributed to coincidence, but he thought it more likely that there are certain genetic relations.

A review of the literature reveals that no positive agreement has been reached concerning the question of a relation between otosclerosis and the so-called ostitis fibrosa.[1] On the contrary, a negative result has been obtained: otosclerosis is not identical with generalized osteodystrophia fibrosa.

All previous research to solve this problem has been made by otologists. For this reason, otosclerosis has been in the limelight of discussion. These investigations were rendered more difficult by the fact that the nature of Paget's disease was not yet definitely determined. In the last decade, however, a more definite understanding of the nature of osteodystrophia fibrosa has been reached through the classic works mentioned in the bibliography. Above all, it has definitely been established by the work of Frangenheim, Kaufmann, Koch, Pick, Schmorl, Willich et al. that there exists a localized form of osteodystrophia fibrosa. Hence the problem under discussion has developed a new aspect: one can balance otosclerosis—as a focal disease—against a localized osteodystrophia fibrosa. The present problem culminates in the question: Does there exist any histologic relation in development between an otosclerotic focus and that of a localized osteodystrophia fibrosa?

From the abundant literature of osteodystrophia fibrosa it is known that the localized form presents the same histologic appearance as a partial picture of a generalized form. The condition may be compared with tuberculosis: one tubercle of a generalized miliary dissemination, from a purely histologic standpoint, gives exactly the same picture as a tubercle of a strictly localized form.

In regard to the histogenesis of a limited diseased area—as represented in the bone changes in otosclerosis—the aforestated question may be expanded: one may substitute the term "partial picture of a

1. The author prefers the modern term "osteodystrophia fibrosa" and follows the classification of Christeller (1926).

generalized form" for "local osteodystrophia fibrosa." Thus the question of distribution (local or general) is eliminated, and the histogenesis of osteodystrophia fibrosa in general may be balanced against that of otosclerosis. However, by no means is this to be taken as a statement that otosclerosis is identical with generalized osteodystrophia fibrosa.

My own studies of osteodystrophia fibrosa began in 1926 with observations made on ground sections of bone in a case of Paget's disease from the collection of Prof. L. Pick of Berlin. The use of the polarized light proved of great value in this connection. Certain diagnostic features of osteodystrophia fibrosa were described which are of importance in the differential diagnosis of doubtful syphilitic lesions in prehistoric bones.

In order to establish a foundation for further studies of bone pathology—especially osteodystrophia fibrosa and otosclerosis—a paper was published in 1928 entitled: "Bone Pathology and Its Relation to the Problem of Otosclerosis." The fundamental aspects of normal bone development were presented from a new point of view, with their significance for bone pathology in general, and otosclerosis, in particular. This led to the conclusion that otosclerosis is primarily a problem of bone pathology rather than of otology.

In a recent paper appearing in German (*Beitr. z. allg. Path. u. path. Anat.* **82**:383, 1929) I have attempted to present the nature of osteodystrophia fibrosa. These investigations were based, aside from the literature and my earlier observations, on observations in a Boston terrier with osteodystrophia fibrosa. The organ of hearing of this animal, however, was not discussed in detail, but was reserved for the present paper, since its significance for the problem of otosclerosis was apparent. Therefore, the following study should be regarded as supplementary to the German paper.

In contradistinction to earlier authors who have studied the problem, I approached the question of otosclerosis from studies made on osteodystrophia fibrosa. Hence osteodystrophia fibrosa will be kept in the limelight.

OBSERVATIONS IN A CASE OF OSTEODYSTROPHIA FIBROSA IN A DOG

SUMMARY OF GENERAL OBSERVATIONS PUBLISHED IN A PREVIOUS PAPER

Before entering into a more detailed discussion of the labyrinthine capsule of the Boston terrier with osteodystrophia fibrosa, I shall give a cursory review of the general observations, as presented in my German paper (1929).

One is dealing with a juvenile hyperostoticporotic form of osteodystrophia fibrosa forming pseudotumors and cysts (so-called ostitis fibrosa von Recklinghausen) in a female Boston terrier of 8½ months [2]). A study of the literature reveals that this form is rare in dogs. It may be of interest to note from the clinical history, that the owner raised the animal exclusively on Spratt's "Fibo" and tea.

This bone disease resembled the snuffles of pigs, referable to osteodystrophia fibrosa (Rehn, Ingier). The upper jaw was distended by a tumorous growth. This was diagnosed as an intra-osseous epulis (Nélaton) originating from the endosteum of the alveolar bone. Many cysts were observed in this new formation, which must be regarded as a "brown tumor" (pseudotumor). The epulis appeared in the course of a generalized osteodystrophia fibrosa and thus not only presented the morphologic picture of an osteodystrophia fibrosa but also bore a genetic relation to this disease.

As for the internal organs, the thyroid showed changes as observed in hypothyroidism, whereas the parathyroids were morphologically normal.

Differential diagnosis excluded rickets, osteomalacia and the generalized osteoporoses. However, a slight scorbutic tendency may have been present. A progressive atrophy of the bone was observed in a limited area, which bore a close resemblance to the dissecting atrophy of Pick. This might well represent an early stage of osteodystrophia fibrosa.

DETAILS OF THE CONDITION IN THE ORGAN OF HEARING

The temporal bones were partially decalcified according to the method of Pommer (Müller's fluid with a small amount of nitric acid). Horizontal serial sections were made after the bones were embedded in a collodion preparation. Some of the sections were stained with Delafield's hematoxylin and eosin, and others with thionin picric acid (Schmorl).

In general, the same changes could be observed in both the right and the left organs of hearing. Thus they may be treated jointly.

Desquamated epithelium was found in the external meatus, on both sides. The tympanic membranes were normal. Likewise, the ossicles showed no pathologic changes. There was no ankylosis of the stapes nor any calcification of the ligamentum circulare. On the right, a coagulated serous fluid, containing no leukocytes, lay around the stapes and in the niche of the round window. The mucous membrane of the middle ear was not thickened. The membranous labyrinth showed postmortem

2. This case was kindly submitted for examination by Dr. H. Searls, veterinary surgeon, and Dr. Philip K. Brown, Chief of the Medical Department of the Southern Pacific General Hospital, San Francisco.

changes and artefacts which obviously originated from the cutting of an incompletely decalcified specimen.

The bony system of the more distant surroundings of the labyrinth revealed essentially the same changes as were observed in the long bones. The tendinous insertions showed resorption by giant cells, as well as fibrous marrow with hyaline islands (fig. 1). However, one found such foci originating not only from the outside, i. e., the periosteum, but also from the inside, i. e., the endosteum (fig. 2). The bone bounding the labyrinthine capsule contained marrow consisting

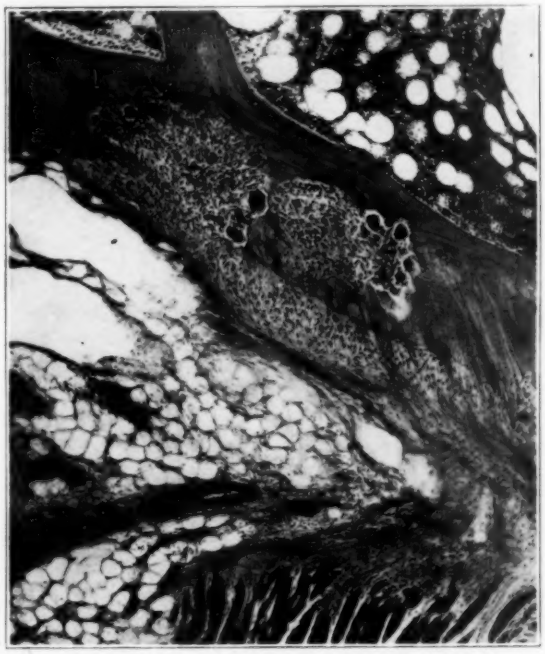

Fig. 1.—Osteodystrophia fibrosa beneath the periosteum and at the tendinous insertions; embedded in a collodion preparation (spec. 545/12), stained with hematoxylin and eosin; seen with Leitz objective 16 mm., eyepiece. 6 ×, magnified 70: 1.

principally of lymphoid and fat tissue. However, where the marrow lay next to the fibrocartilaginous partitions, it became fibrous with resorbing giant cells. The mastoid process was only slightly pneumatized. In general, the spaces of the spongy bone were filled with normal bone-marrow. One portion of the spongy bone presented the picture of dissecting atrophy (fig. 3). This was also observed in the substantia spongiosa of a vertebra.

The bone surrounding the labyrinthine capsule showed, as did the other bones of the skeleton, a typical osteodystrophia fibrosa,

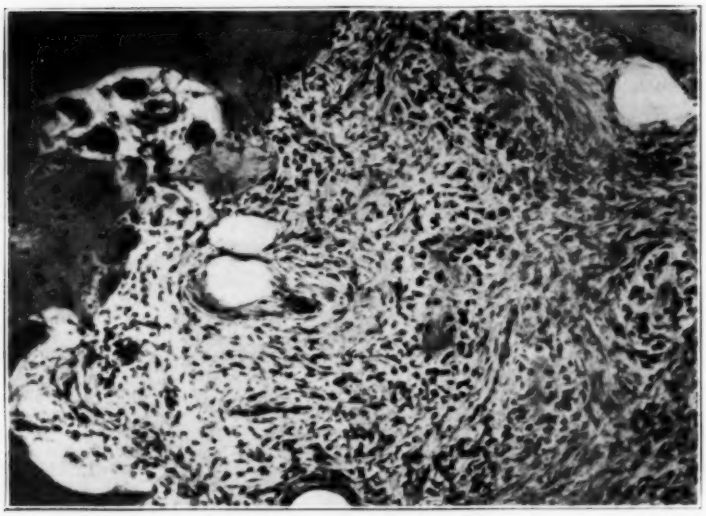

Fig. 2.—Osteodystrophia fibrosa arising from the endosteum, an illustration of the so-called "granulation tissue"; embedded in a collodion preparation (spec. 545/13) hematoxylin-eosin stained; seen with Leitz objective 16 mm., eyepiece 6 ×, magnified 140: 1.

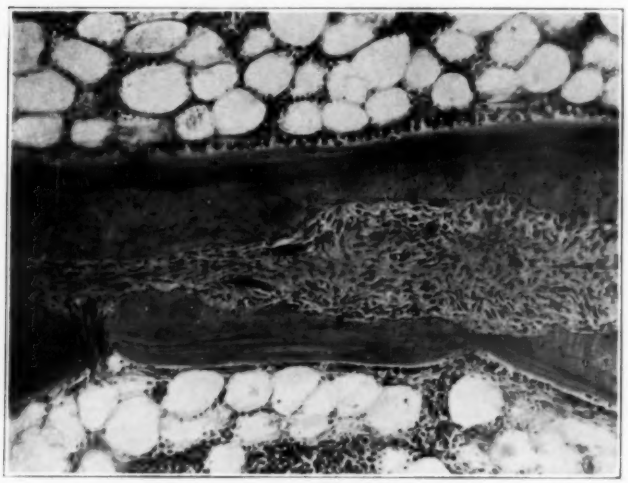

Fig. 3.—Dissecting atrophy within the spongy bone of the mastoid process; resorption by giant cells; fibrous marrow; embedded in a collodion preparation (spec. 545/29), hematoxylin-eosin stained; seen with Leitz objective -6 mm., eyepiece proj. II, magnified 200: 1.

In regard to the problem of otosclerosis, special interest is to be concentrated on the changes in the labyrinthine capsule proper. A low magnification revealed a rarefaction of the capsule (fig. 4). There were more or less irregular cavities, large and small, the relation of the origin of which to the vascular system was evident. Within the cavities were giant cells, which resorbed the bone, enlarging the spaces. Besides giant cells and hyperemic vessels, the cavities contained a young embryonic connective tissue or a more fibrous marrow, typical of

Fig. 4.—Generalized hypo-ostoticporotic form of osteodystrophia fibrosa in the labyrinthine capsule; resorption cavities; giant cells; mesenchymal tissue; fibrous marrow; osteoid tissue deposited in lacunae; embedded in a collodion preparation (spec. 545/15), hematoxylin-eosin stained; seen with Leitz objective 3 mm., eyepiece 6 ×, magnified 75 : 1.

osteodystrophia fibrosa. The walls of the cavities were sharply limited and showed lacunae toward the lumen. In several places, a small osteoid margin bounded the wall. This osteoid portion, for the most part, was separated from the true bone by a visible line of cementum, and must therefore be regarded as a new formation (uncalcified bone).

The processes taking place in the cartilaginous remnants within the labyrinthine capsule require a more detailed consideration: A par-

ticularly large cartilaginous remnant was situated on the right as well as on the left, beneath the horizontal semicircular canal. The cartilage, wound from below around the inner limb of the horizontal canal, ending at the plane of the diameters. The most interesting changes took place at this termination (fig. 5). About in the center of the semicircle there were several cystic spaces, surrounded by hemorrhages and an infiltration of round cells. Toward the loop of the semicircular canal, there was connective tissue containing few nuclei and much hyaline inter-

Fig. 5.—Osteodystrophia fibrosa around a cartilaginous remnant within the petrous bone; calcification of the intercellular substance of the cartilage leading to a "cartilaginous nucleus;" embedded in a collodion preparation (spec. 560/13), hematoxylin-eosin stained, seen with Leitz objective 16 mm., eyepiece 6 ×, magnified 140:1.

cellular substance. This hyaline connective tissue abutted on the cartilaginous remnant. The cartilage cells were vesicularly distended. The intercellular substance was calcified and stained deep blue with hematoxylin. Toward the connective tissue, it became granular, crumbly, and gradually ended. Next to the cartilaginous focus in fig. 5 may be seen a large resorption cavity lined with osteoid substance, which had been deposited in lacunae. Within the osteoid substance lay

large dark cells, of which the nuclei only were visible. The osteoid portion was lined with osteoblasts toward the lumen. Its cavity was filled with vessels, loose young connective tissue and fibrous marrow. Thus, preliminary resorption had ceased and the formation of new bone had been instituted.

The same changes were repeated in other cartilaginous remnants. Everywhere the cartilage was calcified to a great extent and in a process of transformation. The deposition of lamellar bone, however, was minimal.

The conditions in the bone near vessels were of special interest: On the level of a connective tissue partition, directly in front of the cochlear

Fig. 6.—"Blue zones" around a vessel, which is ruthlessly perforating old bone; no cementum line between the blue areas and the old bone; embedded in a collodion preparation (spec. 560/10), hematoxylin-eosin stained, seen with Leitz objective 6a, eyepiece 6 ×, magnified 265: 1.

bone, there was a cavity filled with normal marrow, from which vessels penetrated the bone of the labyrinthine capsule. Figure 6 shows such a vessel, leading from old normal marrow into a resorption cavity. The wall of the canal connecting both cavities was stained deep blue with hematoxylin. The blue area was not set off from the contiguous bone by a line of cementum. Toward the vessel, the blue area gradually continued as an eosin-pink osteoid zone. The resorption cavity was almost completely filled with new shell bone, which was set off from the old bone by a line of cementum. The primarily deposited new bone had the same structure as that of the surrounding bone. Toward

the lumen, the new formation went over into a granular crumbly zone. The lumen itself was lined with a narrow ribbon of osteoid tissue surmounted by a few osteoblasts.

The objection may be raised that these conditions are to a certain degree normal. For this reason, two more pictures will be discussed showing the relation of vessels and bones in this case of osteodystrophia fibrosa.

Figure 7 illustrates another area in the same section. A vessel leading into a resorption cavity had ruthlessly perforated an old lamellar

Fig. 7.—A vessel leading from an old marrow into a resorption cavity lined with new bone formation; cementum line between the old and the new bone, the latter showing three zones: normal bone, blue zone, pink zone (osteoid); embedded in a collodion preparation (spec. 560/6), hematoxylin-eosin stained, seen with Leitz objective 6a, eyepiece 6 ×, magnified 285 : 1.

bone. The old bone showed peculiar changes toward the wall of the perforating canal, as well as toward the wall of the old normal marrow cavity: a granular crumbly zone, stained dark blue with hematoxylin, gradually changing over into old bone without a cementum line. This area continued as an eosin-pink zone. The bone cells no longer showed a halo of protoplasm here. It seemed, rather, that the plasma had become continuous with the plasma of the osteoid matrix. The conditions within the resorption cavity had a different aspect: a definite

cementum line separated the old bone from that newly formed. However, the new-formed bone here also passed gradually over into a granular crumbly zone. The bone cells were surrounded by a light zone of protoplasm. Some cells lay partly in the blue, and partly in the pink zone, the latter lining the resorption cavity. A typical osteoplastic marrow and numerous osteoblasts were observed within the cavity.

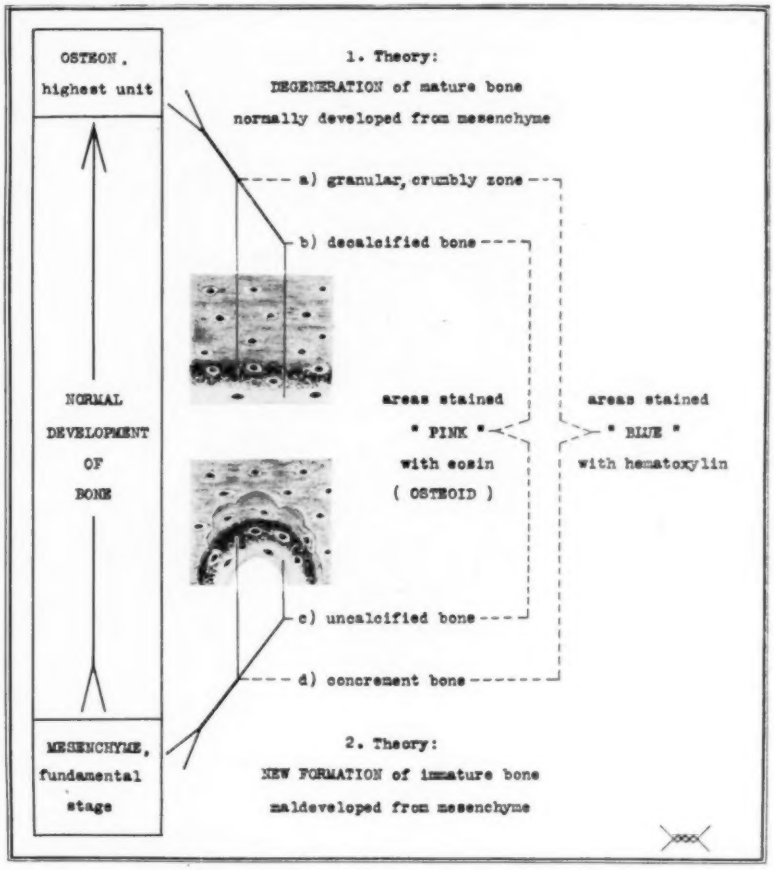

Plate 1.—A graphic presentation of morphologically indistinguishable changes, with a theoretical explanation of their origin.

Comment.—One sees that new as well as old bone revealed the same histologic changes. The question arises: May these zones be traced back to the same or to a different origin?

To elucidate this question a graphic presentation of these morphologically indistinguishable changes, with a theoretical explanation of their origin, was prepared (plate 1). Theoretically, two processes might be assumed to explain the origin of the blue and the pink zones:

(1) degeneration of mature bone normally developed from mesenchyme and (2) new formation of immature bone maldeveloped from mesenchyme. It is probably exceedingly difficult to prove which of the two possibilities holds in the various locations, since an adequate staining technic for the differentiation of the two processes is not had.

The difficulty lies in the fact that one is dealing with an interruption —at the moment of death—of two processes moving in opposite directions (decalcification and calcification). Moreover, it is conceivable that both directions of movement cross a common point. In reality, at this point there would be no chemical difference at all. Let me demonstrate this condition with a simile: if one takes a snapshot of a wheel slowly moving to the right and another of the same wheel in the same position, moving to the left, one obtains two identical pictures, which do not reveal the direction of the movement.

Thus, for the time being, one may answer this question only with probability or with "intuition," as Wittmaack stated. I should like to regard the areas which lie in bone not separated from the surrounding bone by a cementum line as "degenerated" bone. However, when the zones under discussion are situated in a substance separated from the surrounding bone by a cementum line, one is probably dealing with a new formation of maldeveloped bone. One has here a case of osteodystrophia fibrosa. It is possible that the dystrophy attacking the bone by means of the vascular system creates a disturbance in old bone (degeneration, von Recklinghausen; he also may be consulted concerning the relation of osteodystrophia fibrosa to osteomalacia) as well as in new bone in its primary stage of development (malformation). As I said, the effect as seen in the stained specimen, might be the same.

Since newly built bone may be diagnosed by the cementum line (figs. 6 and 7; plate 1, second theory) one might, in this case, speak of a malformation. Malformation is a mere probability, for it might also be possible that the newly built bone had previously normally reached maturity and then secondarily become degenerated. In opposition to such a conception, however, stands the fact that malformation of new bone developing from mesenchyme is a common accompaniment of osteodystrophia fibrosa (fig. 8), as I have pointed out in my German paper (1929), and as mentioned earlier by Mönckeberg and Konjetzny.

In case a cementum line is visible, the condition may be interpreted with fair probability. But there are cases in which a cementum line is not clearly observed (fig. 9). However, here, too, one may be dealing with a formation of new bone. Figure 9 shows the bone conditions in relation to the internal acoustic meatus. The path of the eighth nerve lies below the level shown in this picture. One sees a vessel, surrounded by new bone and a cementum line. The blue areas extend

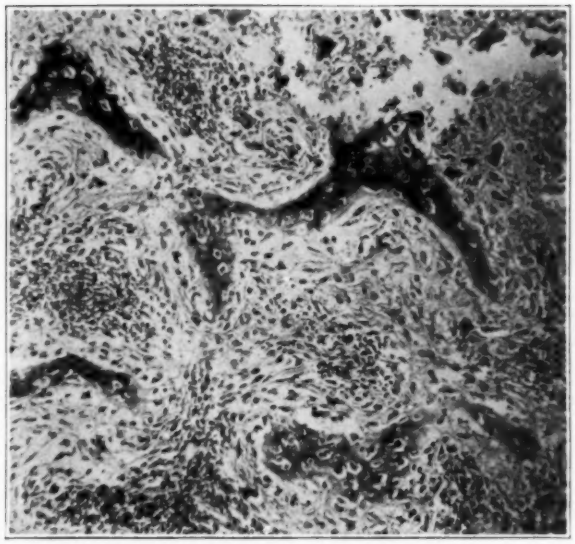

Fig. 8.—Typical picture of osteodystrophia fibrosa from the pseudotumor of the jaw (intra-osseous epulis, "brown tumor," hamartoplasia); giant cells; blood filled mesenchymal sponge; fibrous marrow; fibroblastic osteoid tissue; fibroblastic bone formation ("fibroblastic nucleus"), the latter being the result of maldifferentiation; embedded in a collodion preparation (spec. 550), hematoxylin-eosin stained, seen with Leitz objective 16 mm., eyepiece proj. II, magnified 100: 1.

Fig. 9.—Bone conditions along the internal acoustic meatus, illustrating the difficulty of ascertaining the nature of the blue zones, whether old bone degenerated or new bone maldeveloped; embedded in a collodion preparation (spec. 560/4), hematoxylin-eosin stained, seen with Leitz objective 6a, eyepiece 6 ×, magnified 530: 1.

alike along new and old bone. In some places, this boundary is sharply delimited; nevertheless, no distinct cementum line is visible. Thus, the difficulty consists in determining whether this is new or old bone, a malformation or a degeneration. Plate 2 has been constructed as an attempt to clarify this problem: in case the intercellular substance of

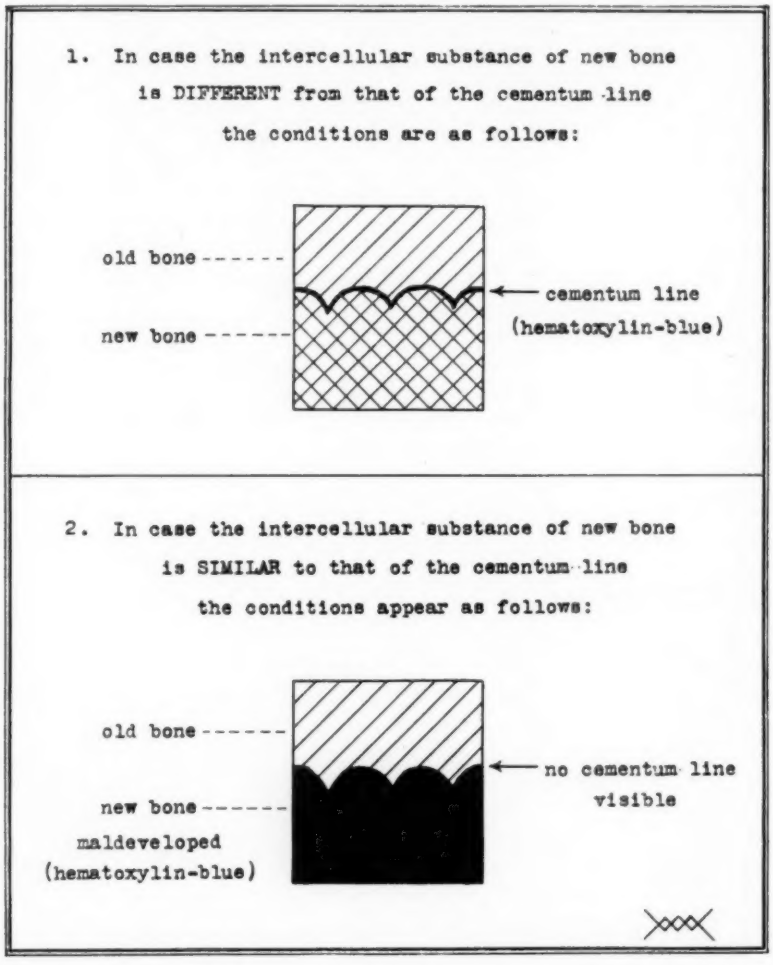
1. In case the intercellular substance of new bone is DIFFERENT from that of the cementum line the conditions are as follows:
old bone
new bone
cementum line
(hematoxylin-blue)
2. In case the intercellular substance of new bone is SIMILAR to that of the cementum line the conditions appear as follows:
old bone
new bone
maldeveloped
(hematoxylin-blue)
no cementum line visible

Plate 2.—A graphic presentation of the relations between the presence of new bone and the visibility of the cementum line.

new bone is different from that of the cementum line, then one will find a cementum line staining blue with hematoxylin, as usual. However, in case the intercellular substance of new bone is similar to that of the cementum line, then a cementum line may be invisible. This would rob one of the last means of identifying new bone in a

hematoxylin-eosin stained section. As a matter of fact, in osteodystrophia fibrosa one observes changes of the intercellular substance which lead to the establishment of such dark blue granular, crumbly, concremented bone (fig. 8; Langenskiöld and Weber also may be consulted). Therefore, it must be kept in mind in making observations in those regions (fig. 9) where the outline is definite and forms lacunae that one may be dealing with new bone, even when no cementum line is visible. Perhaps examinations by polarized light will here decide the question. The cementum lines of ground sections of normal bone cannot be seen in polarized light under gypsum plate "red I. order."[3] In fact, the whole picture is determined by the course of the fibers. This method of polarization (with gypsum plate) is in reality the only method for a selective "staining" of the directions of fibers. Any difference in the course of the fibers, therefore, will determine whether the bone is old or newly deposited in lacunae.

Therefore, the question of the direction of movement (decalcified or uncalcified bone?) ought to remain in the background until a practical technic for differentiation has been established. Rather, one should constantly be aware of the fact that in both cases bone of inferior quality is present.

In the present case of generalized osteodystrophia fibrosa, the bony capsule of the labyrinth was in a stage in which processes of resorption exceeded those of new formation. This stage corresponds with the hypo-ostoticporotic from (Christeller). It is possible, however, that the new formation might have come to exceed the resorption, in which case one would have been dealing with a type corresponding to the hyperostoticporotic form present in the other bones of this animal. Since a sclerotic form may develop from the hypo-ostotic, as well as from the hyperostotic, form, it represents the end-result or healing stage (Christeller).

What relation the changes observed in the labyrinthine capsule of the present case of osteodystrophia fibrosa actually have to otosclerosis, will become evident from a general comparison of the two diseases.

THE HISTOGENESIS OF OSTEODYSTROPHIA FIBROSA IN COMPARISON WITH THAT OF OTOSCLEROSIS

THE QUESTION OF DYSTROPHY AND DEGENERATION

Morphologically, it is much more difficult to predict the future development of an initial stage than to interpret from an end-picture how it has come about.

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3. This plate consists of a wedge of gypsum, which placed between the crossed Nicol prisms produces interference colors of so-called first order (Schaffer, J.: Lehrbuch der Histologie und Histogenese, Leipzig, Wilhelm Engelmann, 1922, p. 103; and Köhler, A., cited by Weber, 1927).

How does the disease begin? This is the most difficult problem of osteodystrophia fibrosa, as well as of otosclerosis. Naturally, the histology at the beginning is closely related to the etiology.

In the case of osteodystrophia fibrosa, the conclusion is that the disease is probably the result of a chronic local or general dystrophy, and that in this manner the localized as well as the generalized forms may be explained. This view does not stand in opposition to the many theories of its origin. Without doubt, it is the vascular system that acts as a mediator between the dystrophy and the degeneration. Especially has venous stasis been held as a cause (von Recklinghausen, Pommer, Lang and others). It would be reasonable to assume a degeneration of bone in the neighborhood of vessels from a dystrophy referable to a venous stasis. However, as convenient as this conception might be, the so-called halisteresis of bone cannot be positively proved morphologically, since we lack, as yet, exact technical methods (Axhausen, Christeller). Thus the question must remain undecided, in spite of the classic investigations of von Recklinghausen.

The same problem arises in regard to otosclerosis. Here also, one finds several authors who hold a dystrophy or rather a softening of the bone (aseptic necrosis, Gray) responsible for the initiation of the process. The theory of venous stasis is championed by Eckert-Möbius, Gibelli, Grünberg, Heyninx, Lange, O. Mayer (1911), Wittmaack and others. The enlargement of the haversian canals has been regarded as the initial stage in the development (Drury, Preobraschensky, Simeoni). Recently, Döderlein took a stand in regard to this important question of degeneration. He came to the conclusion that in the beginning the bony substance undergoes regressive changes. In agreement with Wittmaack, he regarded the "blue coats" around the vessels—first described by Manasse—as such degenerative processes. However, he did not believe, as Manasse did, that the "blue coats" represent new bone. In this respect, one must probably agree with Döderlein, although for the present, proof can hardly be given (the discussion in the foregoing paragraph may be seen).

In my case, also, one observed blue areas along vessels, which may be identified with the "granular, crumbly zone" of Pommer and must be interpreted as evidences of degeneration.

In regard to the primary stage of dystrophy and degeneration in osteodystrophia fibrosa, as well as in otosclerosis, one finds practically the same observations and the same theories and arguments.

While a certain diversity of opinion characterizes observations on the first step of the development in both diseases, a greater unity of opinion is evidenced in observations on the next stage, the reaction.

THE REACTION

Resorption.—Resorption by osteoclasts is an important step in the normal development of bone. In the case of osteodystrophia fibrosa, one can demonstrate that an unknown cause (dystrophy?) leads to a stimulation of the functional bone-building system, which finds its expression in the increased appearance of giant cells. They produce the spaces in which the consequent processes take place.

This could be observed well—in the case under discussion—in the pseudotumors of the jaws. The labyrinthine capsule also showed such cavities resulting from resorption.

The same conditions have been described for otosclerosis. According to Escat (stage of osteo-spongiose), Gray, Heyninx (la phase ostéo-spongieuse), Lange, Lermoyez, Mayer and others, the space in which the otosclerotic focus later appears is produced by giant cell resorption.

Let me emphasize here that such increased lacunar resorption is never found in rickets or osteomalacia. Therefore, concerning this stage of development, I must confirm Mayer when he says " . . . it is quite certain that otosclerosis shows no relationship with osteomalacia or rickets, as certain American authors have believed."

In this connection, the question of the perforating vessels is of importance. From investigations of Pommer, Lang and others, it is known that vessels also exhibit the ability to erode by means of their walls. Concerning osteodystrophia fibrosa, these conditions were studied by von Recklinghausen, Pommer and Lang. For otosclerosis, Wittmaack, Eckert-Möbius and others have stressed the importance of the vascular system as a resorptive factor. Perhaps one might here fittingly call attention to the old "neospongification theory" of Siebenmann.

It is not certain in what manner the resorbing action of osteoclasts and blood vessels may be explained. Recently, the view seems to predominate (Siegmund) that in the case of lacunar resorption (giant cells) the bone must be in a state of readiness for such resorption. This "readiness" (degeneration?) produces the primary stimulation that leads to the appearance of the osteoclasts. Possibly the difference between resorption by blood vessels and resorption by osteoclasts lies in the fact that the resorptive activity of the vessels produces a degeneration of the bone but it is not dependent on such degeneration, while giant cells probably remove only such material as has previously suffered degeneration. Here again one notes the primary importance of the vascular system.

Thus it is seen that there is a correlation of osteodystrophia fibrosa with otosclerosis in regard to the phase of resorption both by giant cells and blood vessels.

In both diseases, mesenchymal tissue appears with the resorption.

Appearance of Mesenchymal Tissue.—The fundamental stage of normal bone development is represented by mesenchymal tissue (Hueck). It is closely related to the vascular connective tissue (Herzog).

In osteodystrophia fibrosa, the cavities produced by giant cells are immediately refilled with such mesenchyme. In the areas of most severe involvement (i. e., intra-osseous epulis), this tissue appears as a mesenchymal sponge filled with blood (Mönckeberg). In the case under discussion, such a mesenchymal germinal tissue was also observed in the resorption cavities of the labyrinthine capsule.

I have interpreted the appearance of this mesenchyme as a result of stimulation of the functional bone-forming system (reaction). Teleologically expressed: the bone-forming apparatus mobilizes its reserve forces—as far back as the youngest stage—in order to repair the defect. Thus, in osteodystrophia fibrosa, the appearance of mesenchymal tissue (reticulated marrow, sponge of "brown tumors") is the expression of the ability of reparation. In contradistinction, the reticulated marrow (Gerüstmark) of Möller-Barlow's disease and scurvy must be regarded as a sign of exhaustion of the bone-forming system.

In regard to osteodystrophia fibrosa, the question has been discussed whether it is the mesenchymal tissue or the giant cells that appear first. If one considers that the newly appearing tissue is closely related to the connective tissue of the vessels (Herzog), one may assume that the mesenchymal tissue and the giant cells arise simultaneously. For didactic purposes only, the stage of resorption has been treated first.

Similar conditions are found in young otosclerotic foci. Here, too, one sees this loose mesenchymal tissue together with giant cells (Escat, Panse; osteoplastic marrow, Mayer).

From an analysis of the next stage it will become evident that in otosclerosis, as well as in osteodystrophia fibrosa, the newly proliferated mesenchymal tissue possesses the ability of reparation.

THE REPARATION

Progressive Stage (Differentiation).—Fibrous Marrow: In the course of the formation of normal bone, a differentiation of cells and an increase of the intercellular substance develop from the fundamental stage, the mesenchyme (Weber, 1928). Pathologically, the same process repeats itself in osteodystrophia fibrosa. At first, fibrous marrow develops as the preliminary result of the differentiation of the proliferated mesenchyme. This fibrous tissue appears in such abundance that the disease has acquired the designation "fibrosa." Besides the elements destined to form bone, in osteodystrophia fibrosa the mesenchymal

elements provided for the formation of the vascular system take part in the differentiation. This process is referable to the pluripotentiality of the mesenchymal tissue (Hueck, Herzog). Now, the histologic picture bears a certain similarity to granulation tissue. In fact, the intraosseous epulis of the jaw, representing osteodystrophia fibrosa, has been pointedly designated as a granulation tumor (Häupl, Lang and others). The great similarity of this histogenic stage to inflammatory granulation tissue prompted von Recklinghausen to regard the nature of this disease as that of an inflammation and to employ the term "ostitis" fibrosa.

In the labyrinthine capsule, also—in the case under discussion—I observed such "granulation tissue" in the cavities produced by resorption.

Recent authors (Rehn, Stenholm, Pick, Weber and others), however, have shown that one may forego the conception of an inflammation in the genesis of the so-called "ostitis fibrosa" if one regards a dystrophy (a disturbance of the metabolism) as the primary etiologic factor. Thus the new designation "osteodystrophia" fibrosa came about.

In otosclerosis, likewise, one finds such a progressive stage, a differentiation from mesenchymal tissue, which at first also appears in the form of a fibrous marrow. Practically all comprehensive papers on otosclerosis emphasize this fact. Good illustrations of this fibrous tissue have been given by Lange, Manasse, Mayer, Wittmaack and others. Mayer said: "The foci of otosclerosis should be regarded as circumscribed forms of fibromatosis." In otosclerosis, exactly as in osteodystrophia fibrosa, there is a participation of the elements destined to provide the vascular system, in the course of the differentiation of the mesenchyme. In this process, likewise, a sort of "granulation tissue" originates. It was just this correspondence with osteodystrophia fibrosa that induced Manasse and Mayer to emphasize a possible correlation of the two diseases. Manasse said (translated): "For I was impressed by this similarity, and von Recklinghausen also at first was of the opinion that the designation ostitis fibrosa would be appropriate. After a more thorough discussion in connection with my sections, he gave preference to the term 'ostitis chronica metaplastica.'" But the assumption of an inflammation and the designation "ostitis" have become permanently established neither for otosclerosis (Manasse) nor for ostitis fibrosa (von Recklinghausen). As shown in the foregoing paragraphs, recently a chronic dystrophy has been held responsible for the origin of otosclerosis (Brunner and others). Thus, without the assumption of an inflammation, one can comprehend the histologic changes of otosclerosis. However, it is still uncertain whether otosclerosis may not also originate from a true inflammatory granulation tissue.

In both diseases, there has been found this stage of reparation just described; for both diseases the theory of an inflammatory origin ("ostitis") has been advanced and the designations "fibrosa" (von Recklinghausen) and "fibromatosis" (Mayer) have been offered.

The differentiation of the mesenchyme, however, does not cease at this point, but continues as a rule.

Formation of "Nucleus": In normal bone development, an increase and differentiation of intercellular substance appears with a more or less pronounced differentiation of the mesenchymal cells (Weber, 1928). This increased intercellular substance seems rather to be the product of a humoral or colloid chemical process (Leriche and Policard) than the result of an activity of already differentiated cells. The differentiation of the matrix is perhaps principally chemical. From such differentiation, evidently two different products result, which, when later calcified, represent, on the one hand, the so-called "calcified connective tissue" (fiber bone, Weidenreich) and on the other, the "calcified cartilage." These two hard substances I have designated as "nuclei," since they act as a foundation for the consequent deposition of lamellar bone (shell bone, Weidenreich).

In pathology, in general, one recognizes again this stage, so far as it concerns the calcified connective tissue, as "metaplastic" bone formation or rather "fibroblastic nucleus" formation (Weber, 1928); thus the term "bone" is eliminated, since it is questionable whether one is dealing with "calcified" or truly "ossified" connective tissue (Weber, 1928).

In the present case of osteodystrophia fibrosa, no fibroblastic "nucleus" formation could be observed outside of the osteogenic area, which could possibly be interpreted as "heterotopic nucleus" formation. However, in the region of the endosteum and periosteum, the fibroblastic "nucleus" formation was increased. These conditions could be particularly well observed in areas of local enhancing of the osteodystrophic process (pseudotumor of the jaw, fig. 8). Between the cells of the "granulation tissue" a hyaline (eosin-pink) substance appeared, which has been designated as "fibroblastic osteoid," as the first step of "fibroblastic nucleus" formation. In later stages, this substance becomes calcified. The color changes from pink to blue-gray in a hematoxylin-eosin stained section. The cells and their canaliculi, embedded in the intercellular substance, could be demonstrated fairly well by thionin picric acid. This type of bone formation was formerly designated as "metaplastic bone," which has been regarded as typical for osteodystrophia fibrosa (metaplastic malacia, von Recklinghausen). Since it is known, however, that, in considering the origin of the new fiber bone, one is not dealing with a direct transformation of one tissue into another, but rather with the flaring-up of a differentiation of a

newly proliferated mesenchymal tissue, preference should be given to the term "fibroblastic" bone formation (Bauer, Christeller, Gruber, Meyer, Weber, Weidenreich). This type of "nucleus" formation was enhanced in osteodystrophia fibrosa. The cavities formed by resorption were filled with a new hard substance, frequently in excess (hyperostoticporotic form, thickening of bone).

In the labyrinthine capsule proper of the present case, the "nucleus" formation was not increased to as great an extent as that observed in the pseudotumor of the jaw. But in the resorption cavities of the petrous bone, hyaline islands were observed which should be designated as "fibroblastic osteoid" islands. Therefore, the changes in the labyrinthine capsule alone must be regarded as a hypo-ostoticporotic form.

The "cartilage nucleus" formation played no important rôle in the long bones of this case, since at the beginning of the disease the cartilaginous remnants of the long bones had for the most part disappeared, because of the age of the animal (8½ months).

In the labyrinthine capsule, however, more or less large cartilaginous remnants are invariably to be found, normally. These remains of cartilage in the present case, were in an active stage of transformation. The cartilage cells were opened, and the intercellular substance calcified. One had here an enhancing of the "cartilaginous nucleus" formation. It must be emphasized, however, that the cartilage was not of metaplastic origin, but rather a remnant of the original embryonic cartilage

In the otosclerotic foci, one finds "fibroblastic nucleus" formation, as a rule (geflechtartiger Knochen, Mayer). Just as in osteodystrophia fibrosa, so in otosclerosis, a hyaline substance appears throughout the more or less differentiated connective tissue, which at first stains pink with eosin but later blue with hematoxylin, as can easily be recognized from instructive illustrations in the papers of Manasse, Mayer, Wittmaack and others. Thus, the similarity to osteodystrophia fibrosa may be ascertained. In otosclerosis, also, the "nucleus" formation, i. e., the appearance of calcified, ossified or sclerosed connective tissue, may exceed the normal, leading to a localized tumorous thickening of the petrous bone (hyperplasia, Mayer). Evidently, it is the intercellular substance that plays the leading rôle. From this point of view the calcification of the ligamentum circulare with a consequent ankylosis of the stapes—as observed in both otosclerosis and osteodystrophia fibrosa (Brunner, Gray, Katz, Mayer, Nager) may be comprehended.

Concerning the stage of "nucleus" formation within the progressive phase of reparation, close analogies have been observed between these diseases; in connection with each, the question of "metaplasia" has frequently been discussed.

The progressive phase of reparation, however, is interrupted by regressive processes.

Regressive Phase (Disturbances of Differentiation).—If the present diseases are in reality caused by a dystrophy, this dystrophy probably lasts throughout the further course of the disease, and continues its disturbing influence on the histologic processes, especially on the newly arisen differentiation.

On the other hand, the theory has been propounded that the regressive changes may be traced back to a primary hereditary faulty mesenchyme (Mayer). In this case, the mesenchyme would entirely lack the ability to form the highest type of bone. As proof of this theory, blue sclerotics and osteopsathyrosis (osteogenesis imperfecta) have been offered (Bigler, Cleminson, Fraser, Gimplinger). However, since these mesenchymal disturbances are not a constant feature in all cases of otosclerosis, this question is not definitely decided as yet and further investigations appear desirable.

In discussing the regressive phase, one should keep in mind that it is not a sharply delimited, independent stage of histogenesis. The various phases of the development do not necessarily appear separately. To clarify the nature of the relation of the diseases under discussion, however, I am treating the phases separately. In regard to the regressive phases of differentiation, I shall distinguish: (1) the lack of differentiation and (2) the faulty differentiation.

Lack of Differentiation: The normal development of bone reaches its climax with the deposition of lamellar bone (shell bone, Weidenreich) on the primarily formed "nuclei" (Weber). This formation of shell bone occurs in the presence or as a result of the activity of osteoblasts, in epithelioid arrangement. The highest unit of bone development is the haversian system, the osteon.

In the course of cases of osteodystrophia fibrosa which I have examined, it could be demonstrated at the point of climax that the highest unit of bone did not appear at all or, at best, as a qualitatively faulty formation, i. e., osteoid. The temporal bone also presented such narrow osteoid ribbons, while the deposition of real lamellar bone was lacking.

The same conditions have been observed in otosclerosis. Here also, in the otosclerotic foci, there is no deposition of shell bone worth mentioning (Brunner, Mayer and others).

In osteodystrophia fibrosa, as well as in otosclerosis, one observes a lack of differentiation, recognizable by the absence or the defective development of lamellar bone.

This lack of differentiation is accompanied by faulty differentiation which indicates the end-picture of the histogenic development.

Faulty Differentiation: The mesenchyme, closely related to the vascular system (Herzog), filling the resorption cavities, is pluripotential. Its differentiation into bone is not the only process; one must also take into consideration the further development of the elements destined to provide the vascular system.

In my German paper (1929) I discussed the regressive changes in osteodystrophia fibrosa comprehensively. Therefore, only a cursory review of the conclusions follows: The young mesenchymal tissue, appearing in the course of osteodystrophia fibrosa, differentiates in a progressive way up to different levels. The progressive tendency exhausts itself and gives way to regression. As a result, maldifferentiation ensues (Konjetzny). The products of this faulty differentiation I have designated as hamartoplasias. As hyperplasias, they represent intermediate formations between true tumors and normal tissue, on the one hand, and between inflammatory repair tissue (scar tissue) and normal tissue, on the other hand. In this connection, I mentioned the experiments in transplantation of embryonic tissue (Carell, Skubiszewski and others). The dense fibroma-like areas within the epulis of the present case must be regarded as such hamartoplasia (pseudofibroma). Likewise, the blue islands of granular, crumbly concrement bone represent such malformation. Beneath the periosteum of the long bones, hyaline islands of dystrophic calcification were found. Such tissue, previously observed, has been identified with keloid by Wülfing, and by Konjetzny as faulty or excessive formation. Within these islands of increased intercellular substance, no nuclei could be demonstrated with either hematoxylin or thionin. They were designated as "maldeveloped" fiber bone.

The cysts within the "brown tumor" may also be regarded as such malformations. They arise, presumably, from those elements that are destined to form vessels. They may originate from cavities resorbed by giant cells, which according to Lubarsch are "maldeveloped detached vessel buds," or from blood sinuses or lymph sinuses (malformation of vessel elements; Stenholm and Hueck may also be referred to). In the formation of these cysts, the surroundings play an important rôle.

Since the changes of the labyrinthine capsule of the present case presented a hypo-ostotic form of osteodystrophia fibrosa, no special conclusions can be reached concerning this stage of the process. A critical consideration of the observations is given earlier in this paper, together with the discussion of the observations made on the petrous bone.

Now, concerning otosclerosis, are there also regressive changes? The investigations of Mayer are of special interest in regard to this question. In his lecture, "The Pathology of Otosclerosis," he came to the conclusion that the otosclerotic foci originate through the patho-

logic growth which has been observed in connection with embryonic malformation: "One could indeed include them with the hyperplasias which are the result of faulty development or lack of development." These few words reveal how extraordinarily close the relations are to osteodystrophia fibrosa if one remembers what has just been stated about the hamartoplasias occurring in this disease. I shall discuss this aspect in greater detail later. Simeoni, Escat, Grünberg, Manasse and others also confirm the idea that the newly built bone is of inferior quality (i. e., malformed).

Thus the conception of maldifferentiation in otosclerosis has been found in the literature, also. Are there histologic proofs of this theoretical assumption? It has been observed that otosclerotic foci present remarkable histologic differences. These differences may be explained, by assuming that the progressive phase is interrupted by regression at various stages. According to Mayer, a fibrous form of otosclerosis exists, in which large areas of the bone are filled with fibrous marrow containing only a few cells. This statement immediately leads one to a comparison with the fibroma-like areas observed in osteodystrophia fibrosa especially as they appeared in the intra-osseous epulis in the present case. On the other hand, he mentioned also a sclerotic form. The newly formed bone is hardened in a peculiar way. The marrow spaces contain only a few cells or are filled with osteoblasts. The matrix of this new bone, staining deep blue with hematoxylin, has been described as "reticulated." Its cells are large and irregular. These islands of bone may be identified with the islands of granular, crumbly concrement bone and the malformed fiber bone as observed in osteodystrophia fibrosa (fig. 8).

The principle of the comparison holds throughout: In osteodystrophia fibrosa and in otosclerosis, "nucleus" formation occurs, during which the intercellular substance, as well as the cells, undergoes regressive changes. A detailed comparison, however, reveals that slight differences may be present. The bone newly formed in otosclerosis is blue (hematoxylin); to this all authors agree. In regard to this fact, the question arises whether one is dealing with "bone" at all. The difficulties evidently consist in our inability technically to diagnose the so-called fibroblastic "bone" as merely calcified or really ossified. For this reason, I have chosen the term "nucleus" and thus eliminated the questionable word "bone." Without doubt, the chemical composition of the "nucleus" is the deciding factor. Mayer expressed the opinion that the hematoxylin blue of the newly builded bone arises from an abundance of cementum. In the progress of "nucleus" formation, no real fiber bone (geflechtartiger Knochen) has been found, but rather a malformation which could be designated as a "cemented connective tissue." The special feature of this malformation and the special com-

position of the intercellular substance might be explained by the extraordinary anatomic conditions of the petrous bone or by the nature of the dystrophy causing the regression.

The histologic differences in various pictures of otosclerosis and the variations from the products of maldifferentiation in osteodystrophia fibrosa are in all probability referable to the different compositions of the intercellular substance. These variations, however, do not at all preclude in principle, at least, the designation of the end-products as hamartoplasias.

Furthermore, Mayer observed a cystic form of otosclerosis as well as a vascular form. This reminds one of the appearance of cysts and blood lakes in the mesenchymal sponge and their relation to the vascular system in cases of osteodystrophia fibrosa, especially their significance for the question of "brown tumors" and the so-called epulis cystica and epulis teleangiectatica (Römer, Siegmund).

Thus, one finds the closest analogies between the two diseases in their regressive phases and their end-product.

A comparison of the single stages of the complete development of both diseases leads to the conclusion: the entire histogenesis in the one is identical with that in the other.

NATURE OF OTOSCLEROSIS AS INFERRED FROM THE COMPARISON WITH OSTEODYSTROPHIA FIBROSA

HAMARTOPLASIA

The opinions of the authors, in consideration of the nature of otosclerosis, seem widely divergent at first glance. On the one hand stands the theory that it is dystrophic and degenerative in its origin (Wittmaack, Brunner); on the other hand, the theory that it is a hamartoma (Mayer). The question arises whether the differences are actually too great to be bridged. The conclusions reached from the comparison of osteodystrophia fibrosa with otosclerosis seem well adapted to accomplish this.

Otosclerosis is to be balanced against a local form of osteodystrophia fibrosa. From the standpoint of histogenesis, it is of less importance whether one is dealing with a truly localized process of osteodystrophia fibrosa or a partial picture (local enhancing) of a generalized form. The so-called intra-osseous epulis as observed in the present case is a formation that challenges a comparison with otosclerosis. From the investigations of Siegmund, it has been proved that the epulis represents a "brown tumor." According to Gaugele, Lubarsch and others, these "brown tumors," however, are not true blastomas, but rather pseudotumors or resorptive new formations. They have a mesenchymal sponge as foundation (Mönckeberg, Konjetzny). As I have attempted to

demonstrate (1929) the appearance of the mesenchymal sponge should be regarded as a consequence of an irritation of the bone-building system. The initial stimulus is probably afforded by dystrophy, degeneration and subsequent resorption. On the other hand, the mesenchymal sponge represents the fundamental stage of the bone-forming process, whence a new differentiation commences with the aim of reparation and the result of malformation. For this malformation, I have coined the term "hamartoplasia" in order to emphasize that one is not dealing with a congenital maldifferentiation (hamartie, Albrecht), either with a hyperplasia of such origin (hamartoma) or with a tumor (hamartoblastoma). In contradistinction, the term "hamartoplasia" indicates a pseudotumor (hyperplasia) of bone which has developed by maldifferentiation from a mesenchymal tissue which is not a congenital remnant but a new appearance during life as a result of irritation of the bone-forming system.

From the analysis of the separate phases of the histogenesis, it has been shown that the development of a local focus of osteodystrophia fibrosa corresponds with that of an otosclerotic focus. It was shown that a special correspondence exists with epulis presenting the picture of osteodystrophia fibrosa; in fact, otosclerosis could be regarded as an "epulis of the petrous bone." Therefore, otosclerosis may also be conceived of as a "brown tumor," pseudotumor or resorptive new formation. In otosclerosis, also, one is dealing with a degenerative, reactive, reparative process: here likewise, one has the question of dystrophy and degeneration, and one has the resorption and the embryonic tissue. One has a flaring-up of differentiation, which gradually exhausts itself after having exceeded the normal measure (hyperplasia). In otosclerosis, in general, true lamellar bone is absent, and faulty differentiation occurs. The end-picture of otosclerosis should be regarded as the picture of hamartoplasia.

This opinion of the nature of otosclerosis does not stand in opposition to the theory that it is dystrophic in origin. Mayer also, in 1911, championed this theory, but later abandoned it in favor of his hamartoma theory. Against the latter, well found objections were raised, especially by Brunner.

The differences of opinion found among authors concerned principally the bone changes in the vicinity of blood vessels. According to Mayer, however, the authors proceeded sometimes from different premises. Especially over the question of the "blue zones," heated discussions were raised. As I have attempted to demonstrate in the discussion of the changes, one must learn to distinguish more definitely between two pictures of different origin: (1) old, degenerated and (2) new, maldeveloped bone.

In regard to the question of hamartoma, I may also offer a solution. As I have attempted to show, the end-picture of otosclerosis reveals a malformation (hyperplasia). Thus far I agree with Mayer. However, I do not think that this malformation is necessarily a hamartoma. A hamartoma is a malformation from a congenital, embryonal germinal tissue. The histogenesis identical with that of osteodystrophia fibrosa and the literature show, however, that the embryonic tissue is newly proliferated as a result of irritation of the bone-forming system by dystrophy. This marks the fundamental difference between hamartoma (Mayer) and my term "hamartoplasia." For the origin of such a formation, the conditions are especially favorable in bone tissue because of its great ability to regenerate.

The conception of otosclerosis as hamartoplasia does not stand in direct contradiction to the other hypotheses of its pathogenesis, but rather represents a link with which these hypotheses may be connected. On the other hand, such a view has the practical advantage that it does not culminate in resignation, as the theory of hamartoma does. It, rather, is accompanied by the prospect of discovering the genetic laws which govern the progression from dystrophy to hamartoplasia. Without doubt, further research on the problem of the genesis will prove of the greatest significance for the etiology and the therapy of both.

OSTEODYSTROPHIA OTOSCLEROTICA

As a result of the comparison of the histogenesis of osteodystrophia fibrosa with that of otosclerosis, it is evident that otosclerosis is a localized osteodystrophia fibrosa, a local porotic hyperostotic form or, in the majority of cases, rather a sclerotic hyperostotic form. Thus the term "osteodystrophia otosclerotica" seems the most satisfactory for characterizing the process. From the standpoint of histopathology, only this localized form deserves the designation "otosclerosis" (genuine otosclerosis).

According to Siegmund, the symptom complex of osteodystrophia fibrosa develops whenever under certain circumstances bone comes to be resorbed. Blood vessels may act as mediators, leading to a degeneration of bone resulting in such a local form. The close relation between the otosclerotic foci and cartilaginous remnants suggests that the picture of osteodystrophia fibrosa may develop also in places in which cartilage becomes resorbed. Possibly in contrast with bone, cartilaginous remnants are more sensitive to dystrophic influences, giving way to resorption earlier than bony tissue in general. This conception, in connection with the actual presence of cartilaginous remnants and the peculiar distribution of blood vessels, would explain the selective involvement of the labyrinthine capsule, and therefore the focal nature of otosclerosis.

Not all these true otosclerotic foci necessarily lead to ankylosis of the stapes. One may have the paradox: genuine ostosclerosis without clinical otosclerotic deafness.

As a local form of osteodystrophia fibrosa, otosclerosis must be classified in the group of metapoetic diseases (Christeller), to which also Paget's disease and von Recklinghausen's disease belong as generalized hyperostotic porotic forms.

THE DIAGNOSIS OF "OTOSCLEROSIS" IN CASES OF GENERALIZED OSTEODYSTROPHIA FIBROSA

As shown in the foregoing paragraphs, in the recognition of the histogenesis of otosclerosis and osteodystrophia fibrosa the question of the distribution of the pathologic processes in the labyrinthine capsule may be eliminated. Under no circumstances, however, in the recognition of the genetic relations of ostosclerosis to generalized forms of osteodystrophia fibrosa may this question of distribution be neglected, since it is of the utmost importance for the clinical aspect as well as for the histologic diagnosis of otosclerosis.

What then is the possibility for making the diagnosis "otosclerosis" from the histopathologic standpoint in cases in which a generalized osteodystrophia fibrosa is present?

At first, one may consider the generalized hyperostoticporotic form of osteodystrophia fibrosa occurring with pseudotumors and cysts (ostitis fibrosa von Recklinghausen). In regard to this form, otosclerosis may manifest itself as a local process. Such cases evidently were observed by Mayer, Jenkins and others. In this case, otosclerosis itself represents a pseudotumor, possibly with cysts. One would then be dealing with an otosclerosis superimposed on a generalized osteodystrophia fibrosa (genuine otosclerosis superimposed on a generalized osteodystrophia fibrosa).

The diagnosis "otosclerosis," however, cannot be made from the histopathologic standpoint in the case in which the nature of the disease as a focal involvement of the labyrinthine capsule is not evident. Such conditions may be observed in von Recklinghausen's disease, if the changes themselves do not present the pseudotumor. The pseudotumor must then be found in another part of the skeleton; otherwise, one is not dealing with von Recklinghausen's disease but with Paget's disease.

According to Christeller, Paget's disease (osteitis deformans) represents the adult generalized hyperostoticporotic form of osteodystrophia fibrosa occurring without tumors and cysts. Concerning the organ of hearing as a partial picture of the bone system, the changes within the labyrinthine capsule are identical whether one is dealing with a case of von Recklinghausen's disease without tumors in this region or a true case of Paget's disease. In either case, the diagnosis "oto-

sclerosis" cannot be made from the histopathologic standpoint. Ankylosis of the stapes, however, may occur owing to the generalized involvement of the labyrinthine capsule. One would then have the paradox: otosclerotic deafness due to generalized osteodystrophia fibrosa without genuine otosclerosis.

In regard to the present case of osteodystrophia fibrosa observed in a dog, one comes to the following conclusion: The skeleton showed a generalized hyperostoticporotic form of osteodystrophia fibrosa. The epulis of the jaw represented the pseudotumor and cysts. One was dealing with a case of von Recklinghausen's disease. The labyrinthine capsule, however, was involved in a form of a generalized hypo-ostoticporotic stage, without pseudotumors and cysts. Thus, one could not make the diagnosis "otosclerosis."

From the foregoing comment it is evident that one may diagnose "otosclerosis" from the histopathologic standpoint only in a case of von Recklinghausen's disease, and then only in a case in which the otosclerosis itself represents the pseudotumor, with or without cysts. The diagnosis "otosclerosis" in a case of Paget's disease is an impossibility from the pathologic standpoint.

SUMMARY

1. Both otosclerosis and osteodystrophia fibrosa represent a degenerative, reactive, reparative process. A dystrophy, presumably through action of the blood vessels, causes degeneration of the bone, leading to irritation of the bone-forming system. This irritation manifests itself in resorption and the appearance of young mesenchymal tissue, which is the fundamental stage of bone formation. From here, differentiation goes on to the formation of fibrous marrow, fibroblastic osteoid and fibroblastic "nucleus" (so-called fiber bone). The highest unit of the bone-forming system, represented by lamellar bone (shell bone), does not develop. Regressive changes, rather, interfere with the separate phases of the differentiation. This leads to numerous maldifferentiations the product of which has been designated as hamartoplasia (not hamartoma), which as hyperplasia is a pseudo-tumor, likewise observed as intra-osseous epulis and so-called "brown tumors."

2. The typical focal otosclerosis is histogenetically identical with a local osteodystrophia fibrosa and may be regarded as a local hyperostoticporotic or local hyperostotic sclerotic form of osteodystrophia fibrosa, an "osteodystrophia otosclertica." It belongs to the metapoetic diseases. Only the cases representing such focal involvement of the labyrinthine capsule ought to be designated as otosclerosis (genuine otosclerosis). In cases of generalized osteodystrophia fibrosa, the diagnosis "otosclerosis" is possible, from the histopathologic standpoint, only in von Recklinghausen's disease (otitis fibrosa) and then only

in case the changes are superimposed and themselves represent as hamartoplasia the pseudotumor, with or without cysts (genuine otosclerosis superimposed on a generalized osteodystrophia fibrosa). The localization of the genuine otosclerosis in the majority of these cases leads to deafness due to ankylosis of the stapes (so-called clinical otosclerosis). It is possible, however, that some of these cases with typical histopathologic otosclerosis do not reveal the clinical aspect of otosclerosis, namely, ankylosis of the stapes (genuine otosclerosis in which a clinical diagnosis of "otosclerosis" is not possible).

3. In cases of generalized osteodystrophia fibrosa, the diagnosis "otosclerosis" is impossible, however, from the histopathologic standpoint: (1) if the changes represent a partial picture of a case of Paget's disease (osteitis deformans); and (2) if the changes are a partial picture of a case of von Recklinghausen's disease and do not present themselves as pseudotumor, the latter appearing rather at another place in the skeleton as "brown tumor" (i. e., epulis). Such a case observed in a Boston terrier has been discussed in this paper. It is possible, however, that these cases with no histopathologic otosclerosis may reveal the clinical aspect of otosclerosis owing to ankylosis of the stapes (clinical otosclerosis in which a histopathologic diagnosis of "otosclerosis" is not possible). As previously stated, these cases must be regarded not as otosclerosis, but rather as a purely generalized osteodystrophia fibrosa (clinical otosclerosis due to generalized osteodystrophia fibrosa without genuine otosclerosis).

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ENDOTHELIOMA OF THE LARYNX*

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NEW ORLEANS

During the last twelve years, I have observed and treated seven patients who had hemangio-endothelioma of the larynx. In the first case, I was at a loss to know what the nature of the tumor was until after histologic study. In the second case, I felt a suspicion, because of the previous experience, and in each of the remaining five cases I was able to present the specimen to the pathologist with a fairly accurate histologic description before his sections were made, and this simply because the characteristics of the tumor were in each instance so similar to those in the first two cases.

All my cases occurred in men, whose ages ranged between 30 and 45 years. Five of the cases were on the left side of the larynx and two on the right side. The patients' habits in point of use of the voice, coughing and consumption of alcohol, tobacco, pepper or hot liquids were extremely moderate or of such nature as not to impress me from an etiologic standpoint. One of the patients was a farmer, two were lawyers in civil practice, one was a traveling salesman of the type residing in the larger cities, one was a minister of minor position, one was a negro gambler and card player and one was a merchant who managed his business. These occupations seemed to be so varied as to have nothing particular in common. Physically, the patients were well developed, well nourished and healthy in all other respects. They had had the mild discomfort from which they sought relief for from three months to a year.

In every instance, the tumor occupied nearly the same spot, five times on the left side and two on the right.

The point of development was apparently just above the free edge of the arytenoid cartilage, halfway between the vocal process and the posterior extremity. The area of involvement was about the size of a green pea, and the tumor looked like a small hemorrhoidal tag, covered, as it was, by apparently normal mucous membrane, soft to the touch; that is, with the patient under suspension laryngoscopy and with the use of a feeler for palpation. It gave one the sensation of touching a tag of tissue which grows from a base that is slightly broader than the apex of the tumor, with a feeling of mild induration at the point of junction of the tumor with its base, as if the tumor were slightly

* Submitted for publication, Aug. 12, 1929.
* Read before the American Laryngological Association.

terraced on its base. At the point of junction there was, in each instance, a tiny reddish ring around the tumor, as if there might be here a circular capillary somewhat larger than the other capillaries which might make up the tumor, though no such capillary formation was visible.

The patients were not hoarse. The cords were white, without injection of blood vessels; their approximation was accurate, and there was no lagging of motion, and yet each of these patients was conscious

Fig. 1.—Whole tumor, capillary type of endothelioma, showing a large blood clot at *A*; × 10. The surface is covered with squamous epithelium.

that something was wrong about the larynx. They complained of voice fatigue and of a sense of fullness, as if some foreign body or growth was there. In no instance did the tumor give rise to any pain, either local or reflex, and it interfered with the voice only in those cases in which, after an incomplete removal, proliferation extended forward to the vocal process or over the free edge of the arytenoid cartilage, and then the voice was only feathery, because the cords even now approximated, but there was a small leak in the interarytenoid space. During

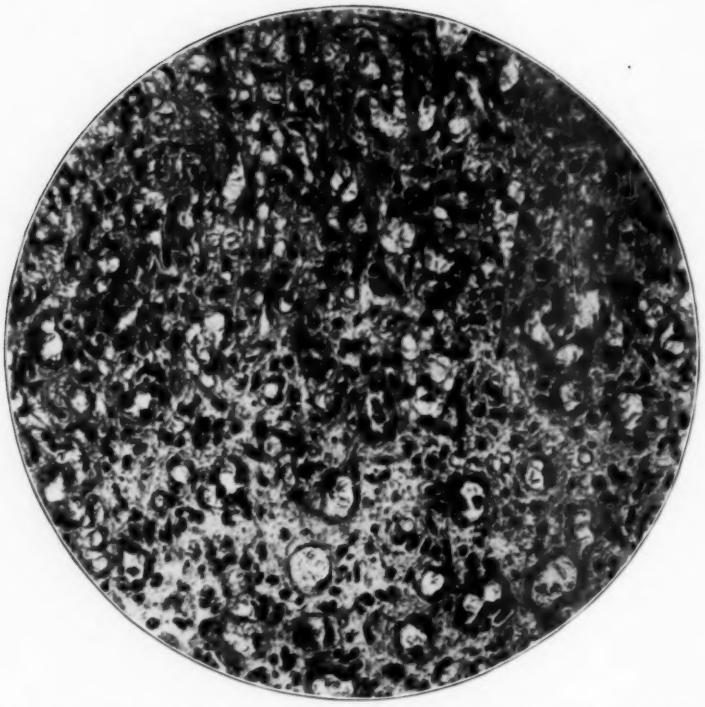

Fig. 2.—Section of the tumor shown in figure 1; × 275. Marked proliferation of endothelial cells is shown, with formation of typical capillaries, some of which contain blood cells.

Fig. 3.—Whole tumor of capillary type with infiltration into base; × 10. Recurrence was prevented by coagulation of its base.

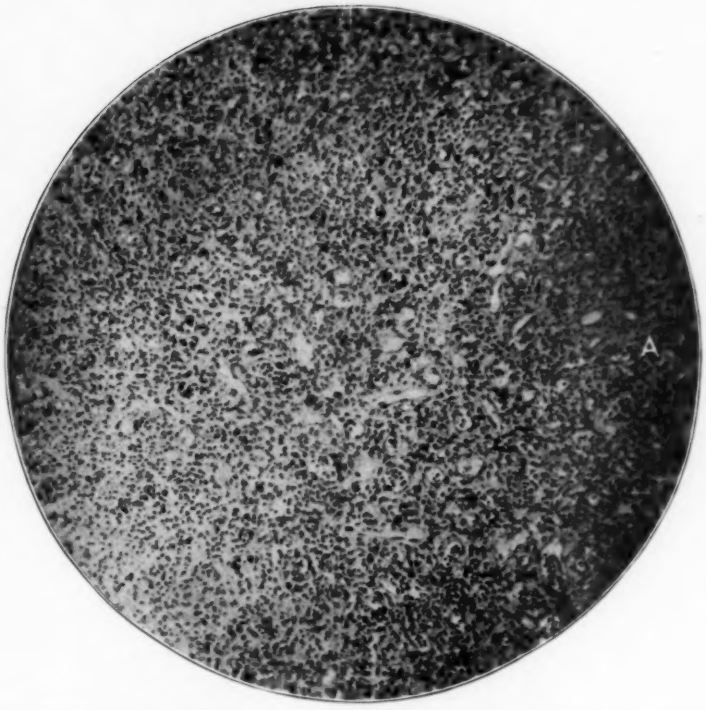

Fig. 4.—Tumor of capillary type with marked inflammatory reaction; × 60. The edges are covered with squamous epithelium (*A*).

Fig. 5.—The tumor cells have large nuclei, indicative of more rapid growth. Many capillaries contain blood. Magnification, × 275.

this phase of secondary proliferation which followed operative intervention, the tumor was nearly flat and appeared more like a pachyderma, except that the central portion was soft and looked like an ulcer on an elevated base. Here, too, one could observe the portion of the original lesion which had healed, and it was easy to see and feel that the scar was closely applied to the perichondrium. There was no evidence by sense of sight or touch to indicate proliferation in this area.

In the first case, I cut the tumor off just below the little red ring described, and covered its base with compound tincture of benzoin. In

Fig. 6.—Whole tumor of capillary type; × 10.

three weeks it had grown; it had not proliferated to its original size, but had broadened out at its base. In the meantime, Dr. John Lanford, pathologist at the Touro Infirmary, who made a careful pathologic study of these cases and also advised me concerning their surgical handling, had studied the sections carefully and made his diagnosis of "endothelioma of the capillary type."

I shall disgress here to quote from the text as follows: "The lining cells of the blood and lymph vessels and subdural spaces arise from mesenchymal cells and are closely related to connective tissue; not only the embryology but also the physiology of endothelial cells

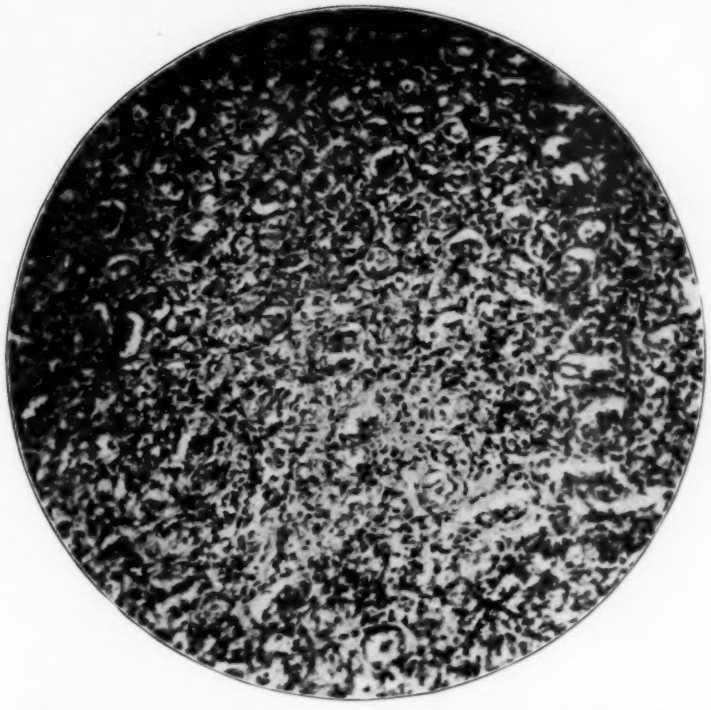

Fig. 7.—Typical tumor pathology; × 60. Many thin walled capillaries and scanty stroma may be seen.

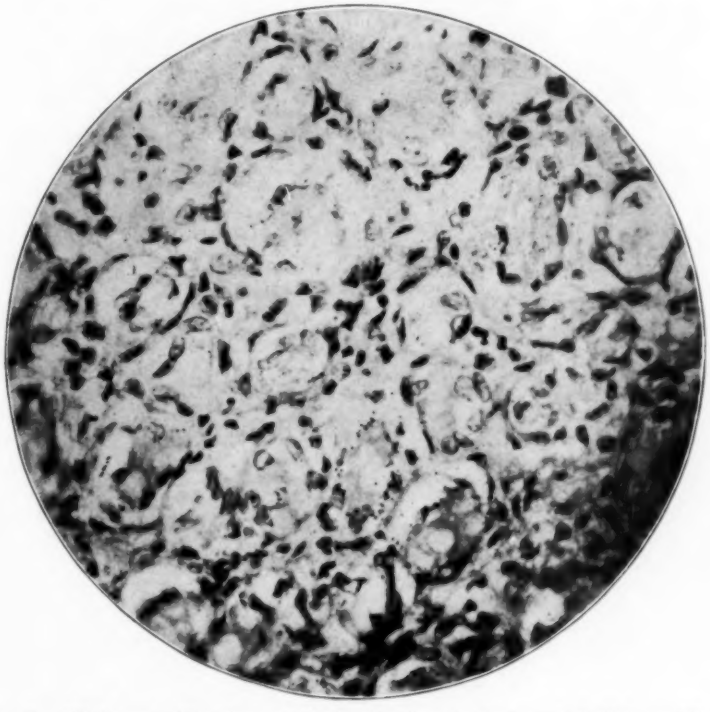

Fig. 8.—High magnification (× 275) showing typical endothelial proliferation with formation of capillaries.

Fig. 9.—Whole tumor of cavernous type; × 10. The large blood-filled sinuses separated by supporting stroma, surfaces covered with squamous epithelium, should be noted.

Fig. 10.—Large, blood-filled cavernous areas lined with a single line of endothelial cells and supported by a stroma varible in amount; × 60. The normal capillary should be noted.

places them in a position intermediate between epithelium and connective tissue."

The cell is large and flat with an oval nucleus surrounded by a moderate amount of delicate cytoplasm. It gives rise to no intercellular substance, and its free border develops no cuticular surface. The function of these cells is to cover surfaces. Under normal circumstances, they possess marked phagocytic properties. They may desquamate and give rise to endothelial leukocytes. They seem to manifest the power

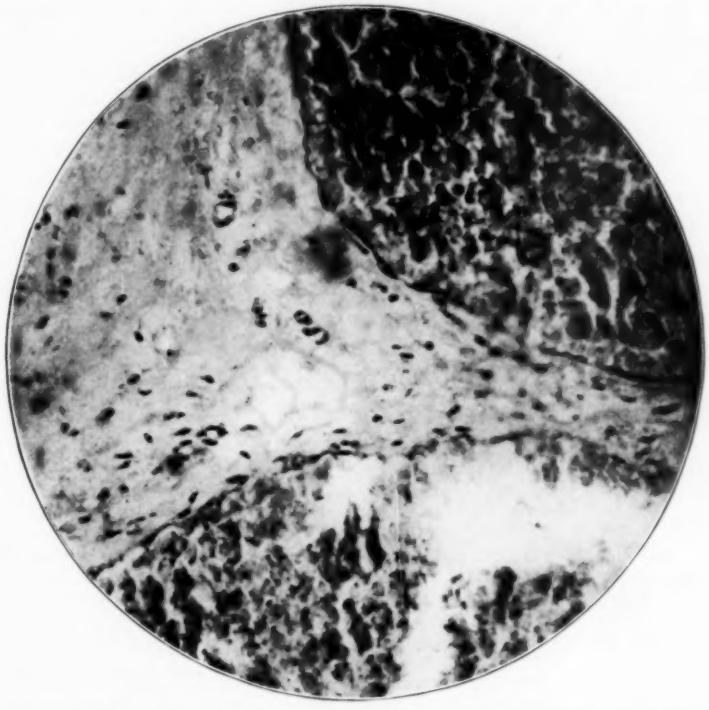

Fig. 11.—Higher magnification (× 275) showing character of stroma and lining cells of caverns.

of proliferation readily, and under the stress of irritation or in the midst of inflammation they manifest this power in a lawless fashion and give rise to the tumors that I have observed.

Endothelioma arising, as it does, from the small vessels or lymph spaces characteristically invades the surrounding tissue through these channels and does not split up the tissue as carcinoma does.

I have noted two types in my cases: the capillary and the cavernous. Other types are recognized when the tumor arises from lymph or subdural spaces.

The growth is said to be slow but progressive, and it is noted for persistent recurrence, due to its infiltrating character, which, one must remember, is far in advance of the visible base; in all my cases, this seemed to be always toward the vocal process rather than away from it, contrary to what one conceives to be the natural flow of both blood and lymph.

The endothelioma does not metastasize until apparently late in its history. None of my cases exhibited this phenomenon, but in similar tumors of the tonsil, soft palate and epipharynx there was metastasis to the bronchial lymph glands, the lungs and the liver. When the growth is observed in the latter locations, the prognosis is usually bad. All of the latter cases terminated in death within two years, differing

Fig. 12.—Whole tumor made up of blood-filled caverns and covered with squamous cells; × 10.

so much in this manner from the laryngeal cases, nearly all of which recurred locally, but all of which finally came to complete recovery.

One must keep these facts well in mind if one is to succeed in surgical treatment in such cases. It took me some time to realize that this simple looking, apparently noninflammatory, hemorrhoidal appearing tag which gave so little discomfort was potentially malignant, and would recur quickly if I was too stingy in its removal. This faculty I exhibited in at least four of the cases, and only then did I realize that the recurrence was due to my irrepressible desire to preserve for these patients their voices.

The method which finally yielded the best results was to operate under suspension laryngoscopy—with general anesthesia—and remove the tumor by dissection, circling the tumor broad of its base in an ovoid manner, with the apex of the oval extending almost but not to the tip of the vocal process, the dissection to extend through the

perichondrium to the cartilage; and then to follow this removal by a careful actual cautery or diathermic coagulation of the entire margin of the wound, including its base. Hemorrhage was of no consequence. It would seem that as long as the tip of the vocal process is not destroyed, the function of the cords remains good. Also, when the cartilage is laid bare, as in this instance, it produces granulation tissue in excess of the margins, which are of soft parts. This granulation of the cartilage is red, bleeds easily and does not have the peculiar gray

Fig. 13.—Thin walled caverns filled with blood and separated by delicate stroma; × 60.

look. It is easily wiped off or removed with a curet, and while it reforms, after one removal it can easily be controlled. It is difficult, however, to differentiate this from an actual proliferation of the tumor cells, and one must watch carefully for induration extending from the base of the former operation, especially toward the vocal process.

It usually takes about three or four weeks for a coagulated wound to heal completely. This is a guide to the differentiation as well as to the induration. The final results in all of these cases have been excellent both from the standpoint of preventing recurrence and from that of preserving a functional voice.

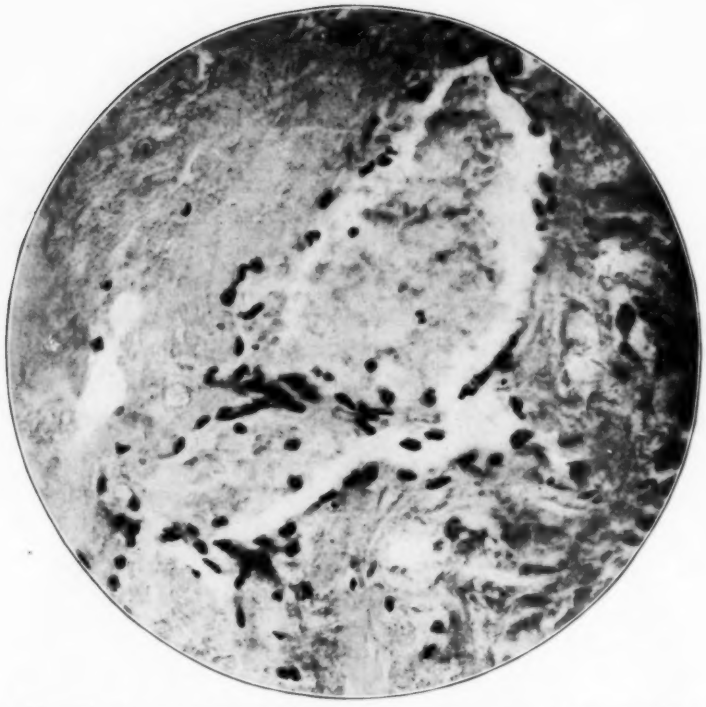

Fig. 14.—Blood vessel lined with a single layer of endothelial cells resting directly on delicate stroma; × 275.

Fig. 15.—Blood vessels lined with a single layer of endothelial cells resting directly on delicate stroma; × 275.

It is now a year since the final healing in the last patient, and he is perfectly well thus far. All of the others have been well to the last date of observation. One died of apoplexy two years ago, but with no local recurrence and apparently no metastasis. The colored patient has not been seen for three years, so that I cannot vouch for him, but he was clinically well and had been so for two years. The remaining five are well.

While these little tumors are not to be compared with those I have observed on the tonsil, epipharynx or hard palate, I may point out that they are not blue or wine colored. They may grow from any location, though I have observed them only at the point described. This fact I have no explanation for, but it is of interest because the location seems to be of diagnostic value. I have never observed one within the cavity of the larynx.

It must be remembered that these tumors are potentially malignant and should be removed with that idea in view. If the field of operation is entirely in normal tissue, the bleeding will be of no consequence and the results satisfactory. Either the actual cautery or, probably preferably, coagulation offers additional safety against bleeding and cell proliferation. The best approach is by means of suspension laryngoscopy.

THE EFFECT OF CAMPHOR, EUCALYPTOL AND MENTHOL ON THE NASAL MUCOSA*

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CHICAGO

In 1927, I [1] reported the effects of menthol, camphor and eucalyptol on the vascular state of the mucous membrane. This consisted of acute experiments on clinical patients and laboratory animals, in which an attempt was made to determine the pharmacologic action of these drugs. I reported that menthol, even in dilutions as low as 0.5 per cent, proved irritating to the mucous membrane, causing a swelling rather than a constriction of these tissues as is popularly believed. On the other hand, camphor and eucalyptol in dilutions up to 5 per cent, although irritating to some degree, cause only a mild local reaction when sprayed into the nose. In this article I shall report the actual anatomic changes produced in the nasal mucous membrane of rabbits sprayed daily over a definite period of time. These experiments were designed to parallel the usual application of these drugs in practice. Liquid petrolatum solutions were used in the following concentration of solute: menthol, 1 per cent; menthol, 5 per cent; camphor, 5 per cent, and eucalyptol, 5 per cent. The animals sprayed with liquid petrolatum served as controls. Ten rabbits were used in each series, and they were sprayed once daily for nine months. At the end of that period the surviving animals were killed quickly with chloroform and autopsy was performed. Paraffin sections of the nasal mucosa were then made. The tissues selected were usually from the posterior or ethmoturbinate of the animal. This tissue was chosen rather than that from the anterior or maxilloturbinate because of the possibility of injury to this portion of the nose while the animals were being sprayed, since it was frequently necessary to get the nozzle of the nebulizer well into the vestibule of each animal's nose. A period of nine months was selected, because this represented about one fourth of the average duration of life of a rabbit. All rabbits used were about 1 year old (adults) and had healthy noses.

A daily history was kept of each animal, with observations as to the amount and type of nasal discharge if any, the general state of activity of the animal and the animal's weight. The solutions were

* Submitted for publication, Aug. 12, 1929.

* From the Departments of Pharmacology and Anatomy, University of Chicago.

1. Fox, Noah: Effect of Camphor, Eucalyptol and Menthol on the Vascular State of the Mucous Membrane, Arch. Otolaryng. **6**:112 (Aug.) 1927.

made up fresh each week, and each animal had its own nebulizer. To avoid contaminations, the nasal tips were sterilized once daily in 95 per cent alcohol.

OBSERVATIONS

A summary of the histories of these animals over the experimental period follows. In the group receiving 1 per cent menthol seven animals survived for nine months, the other three dying of involvement of the lung secondary to an upper respiratory infection. After the third week, these three animals showed until death a continuous nasal discharge, sometimes serous, but most frequently mucopurulent. One of these died in the thirty-fifth week of the experiment, the other two in the fourteenth and twentieth weeks, respectively. Autopsy of the animals that died prematurely invariably revealed pansinusitis with purulent bronchitis and pneumonia. At autopsy the surviving rabbits showed a purulent infection of the mucosa of the nose and sinuses.

The animals sprayed with a 5 per cent menthol-liquid petrolatum solution fared only slightly worse. From the third day of treatment their noses began to discharge first a serous, then a purulent secretion; they lost more weight than the first group, and were apparently very much annoyed by their treatment. The drug caused much sneezing and probably pain, since the animals struggled and squealed after they were sprayed. There were six survivors at the end of nine months. One of these, however, died of a generalized saprophytic infection in the sixth week. The nose, bronchi and lungs of this animal, though showing some evidence of inflammatory changes, were not primarily involved in causing death. The other three animals died in the twelfth, thirteenth and twentieth weeks of the experiment. Autopsy on these animals revealed observations similar to those noted in the previous group, namely, a purulent rhinosinobronchitis with numerous miliary abscesses and consolidation of lung tissue. When the surviving rabbits were killed, they were found to have acute inflammatory changes in the nose and sinuses. Two of these revealed areas of hyperemia in the lungs; one revealed an abscess of the parenchyma of the lung.

The group of animals sprayed with 5 per cent camphor had little difficulty until the fourth week, when they all developed a serous discharge from the nose. Except for three of the animals, which died, the surviving animals went through the experimental period exhibiting alternately a serous and a purulent nasal discharge, but seemingly otherwise not very much disturbed by the drug. They maintained their weight well, and gave little evidence that camphor irritated their noses. One of the animals that died caught its head between the wires in the door of the cage and strangled. The other two developed "snuffles," probably one from the other, since they were in the same cage. All of

these animals died before the tenth week. The animals killed at the end of the ninth month showed evidence of a purulent rhinitis, but the picture was less stormy than in the previous groups, and the accessory sinuses were very little involved. Two of these animals, though showing no evidence of bronchial involvement, had several small soft abscesses in the lungs.

The animals sprayed with 5 per cent eucalyptol responded very much like the previous group. Three animals died in the fourth week from "snuffles." The others seemed contented, ate well and maintained their weight. After the third week all had a nasal discharge, which

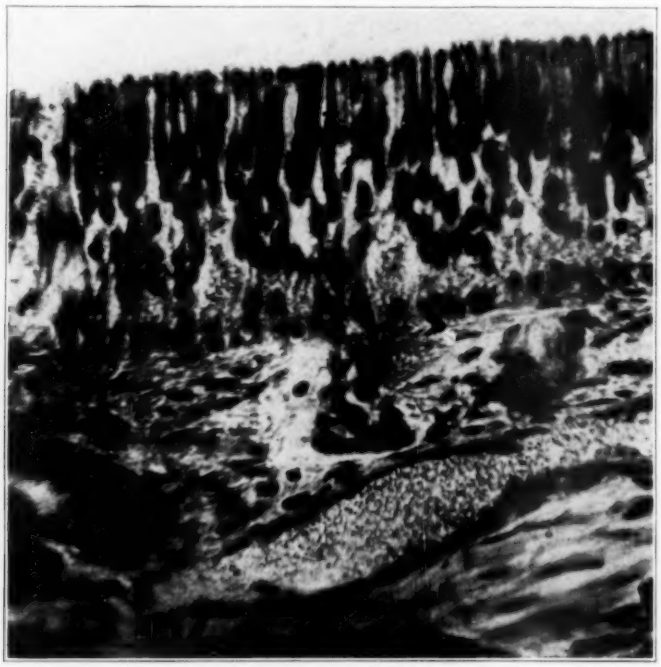

Fig. 1.—Effect of 1 per cent menthol.

was serous at times and at other times purulent. At autopsy, the animals killed at the end of the experiment seemed to have slightly more nasosinus involvement than the group treated with camphor. About half had pus in the nasal sinuses, and three had small areas of hyperemia with incipient abscess formation in the lungs.

Four of the animals sprayed with liquid petrolatum died from "snuffles" before the fifth week. The other six acted very much like those in the previous two groups. At autopsy, however, the nose and sinuses were even less involved than those of the group treated with

camphor. In only one animal was pus found in the sinuses. Two of these animals had minute abscesses in the lungs.

To recapitulate, it may be said that the animals tested with 5 per cent menthol fared the worst; with 1 per cent menthol, better; with eucalyptol and camphor, about the same, but better than those in the 1 per cent menthol group. The animals sprayed with liquid petrolatum fared the best, though apparently some changes were occurring in the upper respiratory tracts.

It is my opinion that the abscesses of the lungs noted were possibly aspiration phenomena occurring during the spraying of the animals, since some animals of each group exhibited this condition.

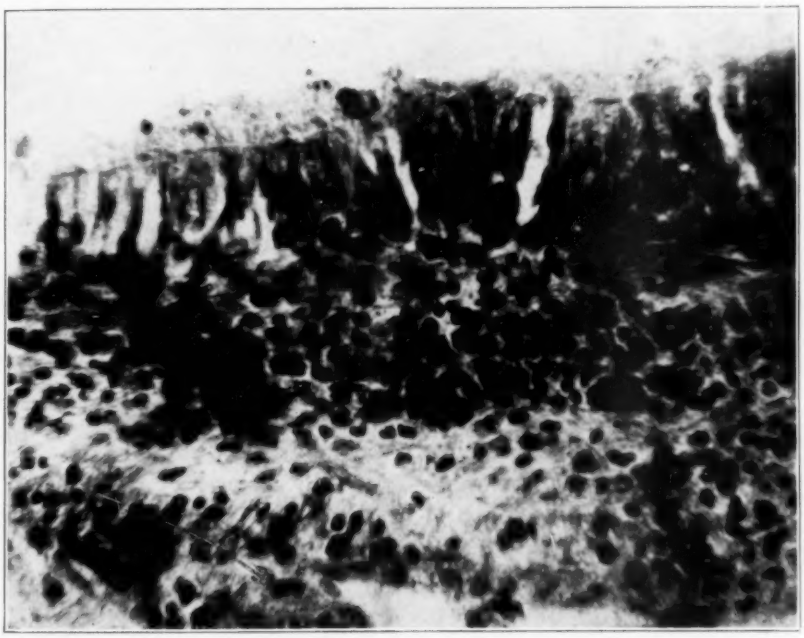

Fig. 2.—Effect of 5 per cent menthol.

Figure 1 is a section taken from the posterior turbinate of the nose of an animal treated with 1 per cent menthol. The epithelium is covered with exudate and is edematous; some of the cells have undergone necrolysis. The tunica propria is infiltrated with round cells, its vessels are dilated and engorged, and the glandular elements are swollen. There is evidence of old tissue injury as well as of regeneration of new tissue.

Figure 2 is a paraffin section taken through the posterior turbinate of one of the group treated with 5 per cent menthol. It may be noted that actual destruction of the nasal mucosa has taken place, the tunica propria is infiltrated, and an abscess has formed in this area. The

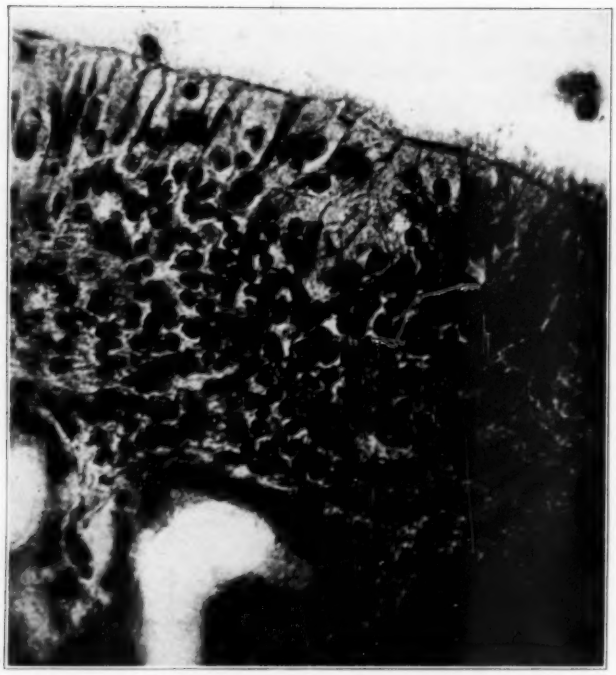

Fig. 3.—Effect of 5 per cent eucalyptol.

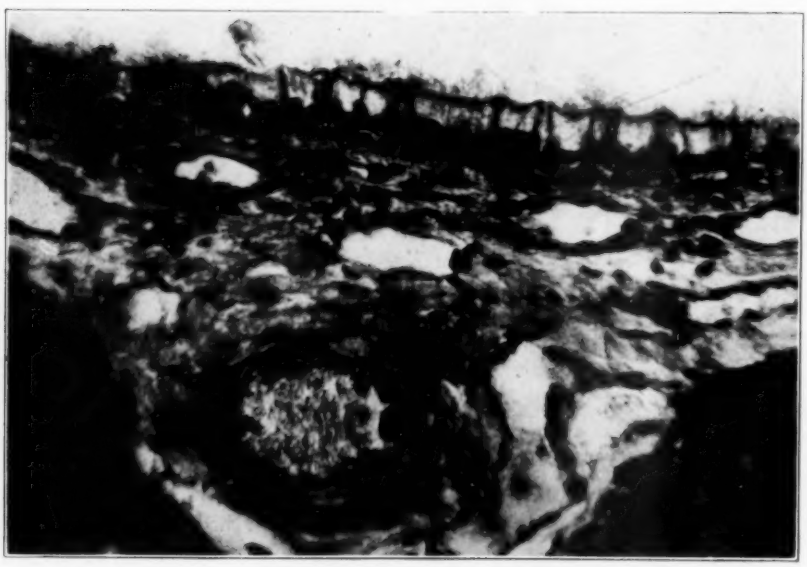

Fig. 4.—Effect of 5 per cent camphor.

Fig. 5.—Effect of liquid petrolatum.

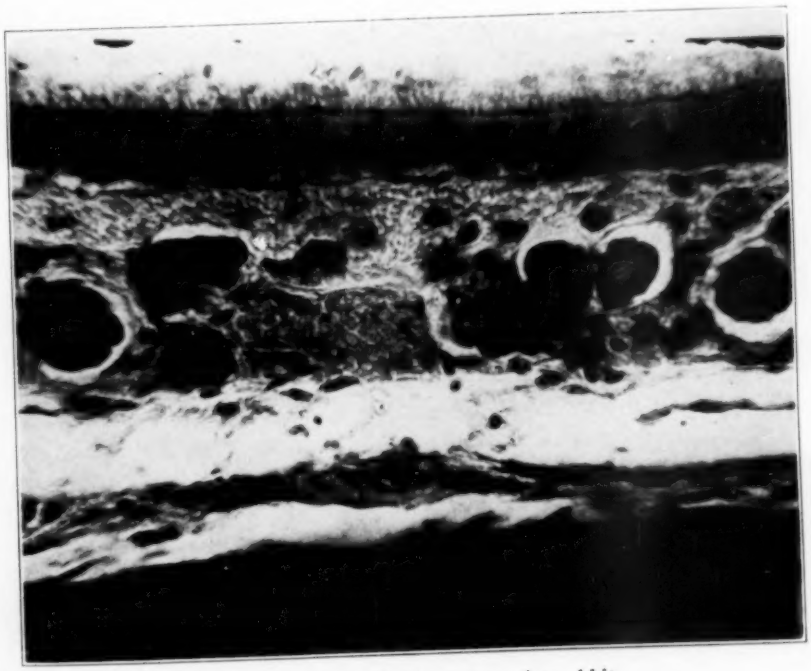

Fig. 6.—Normal nasal mucosa of a rabbit.

vessels are engorged, the glands are swollen, and all the evidences of an intense inflammatory condition are present. Many small intra-epithelial abscesses are evident, with numerous grouped goblet cells dipping into the substantia propria.

Figure 3 is a section taken from the posterior turbinate of an animal treated with 5 per cent eucalyptol. The epithelium is swollen, but fairly well intact. There is some round cell infiltration and engorgement of the vessels of the substantia propria. A few intra-epithelial abscesses are present.

Figure 4 is a section taken from the posterior turbinate of an animal treated with 5 per cent camphor. Here, as in figure 3, there is evidence of mucosal injury, not as great, however, as that seen in the menthol sections. There is desquamation of the surface epithelium, but the submucosa is in fairly good condition.

Figure 5 is a section taken from the posterior turbinate of animals treated only with liquid petrolatum. Even here there is evidence of mucosal injury, although no other drug was used. The surface epithelium is desquamated, and many polymorphonuclear leukocytes and plasma cells are present. There are few polymorphonuclears in the substratum. There is a tendency toward new growth of epithelium.

Figure 6 is a section taken from the posterior turbinate of a normal animal for comparison with those previously described. The differences are at once apparent.

CONCLUSIONS

1. When applied to the nasal mucous membrane of a rabbit for nine months, menthol used in dilutions as low as 1 per cent causes some degenerative changes.

2. When applied to the nasal mucosa of a rabbit, menthol in 5 per cent dilutions causes definite destructive changes throughout all layers of the nasal membrane.

3. Five per cent eucalyptol and 5 per cent camphor have some deleterious effect on the nasal mucosa of a rabbit when used daily for nine months.

4. Liquid petrolatum apparently also exerts a deleterious effect on the nasal mucosa of a rabbit when used for nine months.

FURTHER OBSERVATIONS ON DENTAL CARIES AS A CONTRIBUTING FACTOR IN MAXILLARY SINUSITIS *

GORDON BERRY, M.D.
WORCESTER, MASS.

A year ago, I proposed to the members of the American Laryngological Association that 60 per cent, and conceivably 80 per cent, of patients with paranasal sinus disease would show some form of dental caries in the antral bony floor. I had investigated 152 consecutive antral cases with rather special reference to the subjacent teeth. The matter was difficult of proof, but it seemed reasonable to conclude that if there was an abscessed tooth just under a suppurative maxillary sinus and if the dental infection in all probability antedated the sinus infection, one might consider the trouble to have originated in the tooth. In that case, as the condition became more advanced, the infection would pass

TABLE 1.—*One Hundred Fifty-Two Cases of Maxillary Sinusitis and the Possibility of Their Origin in Dental Caries*

	Origin in Dental Caries			
	Not Possible	Possible	Probable	Proved
Per cent of cases.....	11	41	30	18

from the tooth to the antrum, to the ethnoid sinuses and perhaps to the frontal sinuses, being carried there by blowing or by the slower process of membranous degeneration and change. Table 1 gives a summary of my observations.

The 11 per cent without possibility of origin in dental caries represented cases of sinusitis in which all the teeth seemed healthy. The 41 per cent in which such an origin was possible represented the cases in which a dead tooth was in the floor of the diseased antrum but no x-ray or clinical proof was had of any active dental abscess. The "probable cases" were those in which not only a dead but an abscessed tooth was in the antrum floor, but final proof of the connection between the infection of the tooth and the sinusitis was still lacking. The "proved group" were the cases in which the sinus infection cleared after an established dental apical infection had been eliminated from the floor of the diseased antrum.

* Submitted for publication, Sept. 16, 1929.

* Read at Atlantic City, N. J., before the American Laryngological Association, on May 21, 1929.

A SECOND SERIES

The helpful discussion following my presentation pointed out to me that my effort at inclusiveness in my terminology and at brevity in my paper had led to a few justifiable misunderstandings of my meaning. Furthermore, I did not feel that this limited series had proved my proposition. During the succeeding eleven months, I have endeavored to study a second series, and to study it more in detail, in an effort to support or deny my original conclusions. Of 746 new patients in the office during this eleven-month period, there have been 81 with maxillary sinusitis. Eight of these were children of less than 18 years of age. In the first series there were nine. These children offer possible confusion by reason of differences in individual diagnosis and differences in climatic influence throughout the country. In an effort to be more specific, I am confining this consideration to the 73 adults. Each adult's case was diagnosed as one of antral trouble through the standard observations: history, congestion or polypi of one or both

TABLE 2.—*Seventy-Three Additional Cases of Maxillary Sinusitis and the Possibility of Their Origin in Dental Caries*

	Origin in Dental Caries				
Form of Maxillary Sinusitis	Not Possible	Possible	Probable	Proved	Total
Acute	4	7	3	1	15
Chronic	2	17	24	15	58
	6	24	27	16	73

sides; a nasal suppurative discharge from the middle meatus; localized pain; a shadow over the affected sinus; a corroborating roentgenogram when I was in doubt, and sometimes an exploratory tapping and irrigation. The teeth were all carefully transilluminated. Then the case was referred for tests of dental vitality and a roentgen examination, the report and films being returned to me for study.

Table 2 gives the summary of this investigation, the same grouping being used as in my first series.

Twelve of the sixteen "proved cases" had fistula into the antrum after the abscessed tooth in the floor had been extracted. With healing, the trouble in the antrum ceased. There was one case in which a dental extraction was followed by such a fistula, but no previous trouble in the antrum could be demonstrated; this case was not included in the series. Table 3 sets forth the results reduced to percentages without fractions.

Deductions.—Some of the patients came to the office but once or twice; others went to their dentists for dental extractions and did not return; some were followed through to recovery. Conclusions cannot be absolute, but the work was undertaken conscientiously and does give

certain definite results. In only six of these adults, or 8 per cent, did I find no dead or abscessed tooth in the antral floor and no history of such being extracted. At the other end of my table, my last year's 18 per cent of "proved cases" is shown increased to 22 per cent. It is the remaining 70 per cent that introduces the uncertainty. Last year, I felt that the "probable group" could fairly be included in my estimate. This would give me a total for this series of 59 per cent in which the infection of the antrum was "probably" of dental origin. I know that this 59 per cent had in each case a demonstrable abscessed infection of the root of the tooth just below the involved antrum. Whether this demonstrable infection caused the antral infection is a matter of surmise; but it is a logical conclusion. This estimate comes very near the 60 per cent of my last year's estimate. There remains the 33 per cent in the "possible" column. This is debatable ground. I am content to leave it so, if I can gain for each of these "possible cases" in your own offices a careful consideration of the dead teeth as sources of the

TABLE 3.—*Possibility of Origin of Seventy-Three Cases of Adult Maxillary Sinusitis in Dental Caries, Expressed in Percentages*

	Origin in Dental Caries				
Form of Maxillary Sinusitis	Not Possible	Possible	Probable	Proved	Total
Acute	5	10	4	1	20
Chronic	3	23	33	21	80
	8	33	37	22	100

antral infection. As the study of all dead but not demonstrably abscessed teeth progresses, I am finding that in many instances they are real trouble-makers. If the evidence justifies, these infected foci should be eliminated. Leading internists are taking this position. The results are justifying such extractions. Bacteriologic examinations of their root canals sometimes reveal forms of *Streptococcus hemolyticus*. Laboratory workers are finding such infections even in teeth that are dying but not yet devitalized. Gross evidence against dead teeth in the floor of a large antrum is yet harder to find, for any infection escaping from the dental canal has but a short jump before it reaches the antrum. Then a fistula is established and there is but little more bony necrosis that can show in the film. The infection seeps directly into the antrum, and its only exit is out through the nose. Any tooth that is immediately beneath a diseased sinus, and that shows dark on transillumination, should be viewed with intense suspicion. My plea is that the rhinologist make it his business to investigate such teeth and not rely on the patient's or the patient's dentist's cursory statement that all is well. The technic is simple. The whole procedure takes but a moment.

TECHNIC OF ASCERTAINING DENTAL CARIES IN CONNECTION WITH MAXILLARY SINUSITIS

For the examination of the sinus a dark room is necessary. It is easier if the routine examining room can be so used; then the patient remains in the same chair. The dental transilluminator is connected to the city electrical system through a small rheostat control. The lamp with the current at its maximum, is used to transilluminate the frontal sinuses. Then it is used to light up the antrums, being placed first under the right lip outside of the teeth in the extreme upper posterior sulcus. The amount of light that comes through just below the right inner canthus is noted. Sometimes the amount of light seen in the right pupil is a help. The same procedure is carried out on the left side and is repeated on the two sides, if necessary. If the skull is thin, the rheostatic current is cut down so as to lessen the light and better differentiate shadows. Then the midpalate position is used, which permits a simultaneous study of both antrums. Placing the lamp in the orbit just over the edge of the infraorbital ridge and inspecting the hard palate on that side has not proved to be so satisfactory in my hands, but it is essential if there is any edema of the cheek. An idea of the ethmoid sinuses may be gained by looking in the nose during the orbital or the posterior dental position. The lamp should be shaded from the examiner's eyes, when necessary, by a super-

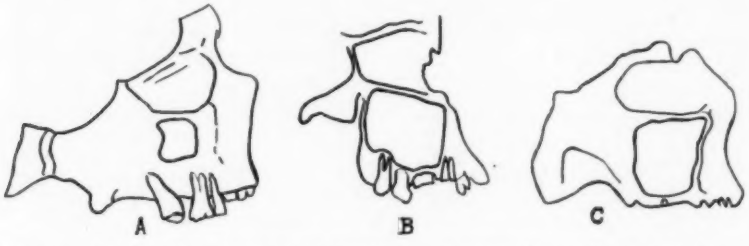

Fig. 1.—Tracings from anatomic specimens showing the antrum, with the orbit above and the teeth below. The nose would be to the right. *A*, the high antrum; *B*, the one with mounding teeth; *C*, the one with a root in the floor.

imposed thumb or by a short rubber-tube sleeve. This entire procedure takes but a moment and concludes the transillumination of the sinuses. Then, with the same equipment, but with the rheostatic current cut down to its minimum, the lamp is placed on the inside of and against each alveolar process, and the outside surface inspected for tooth root shadows. Next the lamp is placed outside of the alveolar process and the tooth roots are studied from the inside. Movement of the lamp helps to demonstrate shadows. A characteristic dead tooth is dark, while the other teeth are light. This darkness becomes a shadow that extends up the root of the tooth. If the dentist has treated the canal of the dead tooth with silver nitrate, the shadow is intense. In the case of an upper molar that is dying, I can sometimes discriminate which of the three roots is abscessed, so refined is the transillumination. Fairly frequently one finds a diseased tooth-root, or localizes a pathologic change in bone where the tooth has been removed and the gums have long since healed. Another type of shadow is one along the edge of the gums and up on the affected alveolar process, caused by pyorrhea. Here the pathologic bone change is superficial as against the deep pathology of an apical abscess. A recently extracted abscessed tooth leaves in the alveolar process the same deep-seated shadow as if the tooth were there.

Reliability of the Test.—A pertinent question would be as to how sensitive and how reliable this transillumination is. As far as the maxillary sinuses are concerned, it has found many diseased antrums that only a clear film demonstrates, and the average roentgenologist cannot always show a good picture of the sinus. The dental transillumination rarely fails to find the bad teeth and even shows up a tooth that is beginning to go, and that only vitality tests in conjunction with other evidence can demonstrate. It is my custom to send my patients, when possible, to a dental roentgenologist for the x-ray pictures of the teeth and for careful review of the case. The patient takes with him my tentative rhinologic diagnosis and a list of the teeth in which infection is suspected. I estimate that this list names four of five diseased teeth correctly.

Illustrative Cases.—Four case histories are appended, selected from the second series, as illustrative cases.

CASE 1.—Miss C. K., aged 23, had an acute right maxillary sinusitis. This was one of repeated attacks which came on with each cold. Examination showed the right antrum darker than the left but not opaque, and only one tooth with a shadow over its roots, the upper right first moler. An x-ray film showed a definite abscess or granuloma over its anterior buccal root. This tooth had given

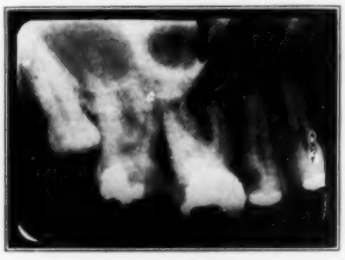

Figure 2

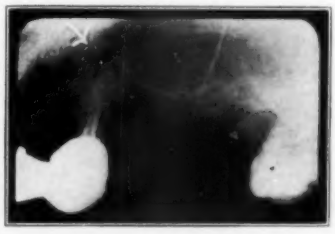

Figure 3

Fig. 2 (case 1).—First molar abscess breaking through the floor of the antrum.

Fig. 3 (case 2).—Abscessed bicuspid. The fistula into the antrum may be noted.

no pain, and she had supposed it sound and healthy. A skilled dental surgeon removed this tooth and found a small fistula leading directly into the antrum. I think of this as an early case which ultimately would have developed into a typical case of chronic suppurative antrum. I anticipate no further antral trouble, provided the bony necrosis in the antral floor is not so advanced as to continue to irritate.

CASE 2.—Miss A. S., aged 22, came to me with a recent buzzing right-sided tinnitus, but with good hearing, some pus in the right middle meatus and more dropping back in the nasopharynx, a dark right antrum, and a dark upper right first bicuspid tooth. An x-ray film showed an abscess at the root of this bicuspid, which reached the floor of the antrum. The dentist thought, as I did, that he could see a break at this point in the bony floor of the maxillary sinus. The tooth was removed, but careful probing revealed no gross fistula. Three weeks later, without any treatment of the antrum, the nasal pus had cleared and the right antrum transilluminated almost as clearly as the healthy left one.

CASE 3.—Mrs. J. E. C., aged 31, came with an acute right antral and frontal pain. This was the second attack, each time on the same side, and each attack following swimming and diving. The swimming and consequent chilling would probably be considered adequate cause, but the nose seemed as mechanically free on the right, excepting for the congestion, as on the left. Why then should it elect the right side? Transillumination showed not only a dark right antrum and frontal, but a dark upper right second bicuspid, the only bad tooth. The patient had been to her dentist regularly and had been assured that the teeth were doing well. The removal of this bicuspid made a small fistula into the antrum. She remained under the dental surgeon's care for a little while and returned to me three weeks later; I then found the tooth area healed, the nose clear and free, and the antrum clear on transillumination. The only treatment

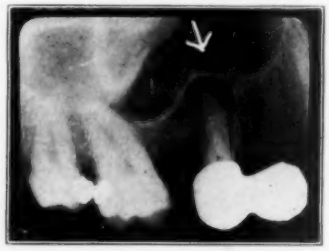

Fig. 4 (case 3).—A large unsuspected abscess just beneath the diseased antrum. Prompt and permanent relief followed extraction.

Fig. 5.—A case similar to case 4. Extraction of these two first molars resulted in a fistula into the left antrum. The infection cleared after three irrigations. Healing was prompt and there was no recurrence.

that she had had from me was a little ephedrine oil for the nose, to keep the tissues shrunk and the passage open. I asked her to be cautious at first about diving, but I am optimistic that she will have no more trouble from this source.

CASE 4.—Miss F. C., aged 45, had a chronic right maxillary sinusitis. There were several diseased, devitalized teeth, but especially did the upper right second molar look dark on transillumination and showed an abscessed condition in the film. This was removed, and the removal left a large fistula into the antrum. Probing through this fistula revealed granulations in the antral floor. I irrigated the antrum through this fistula five times in three months. She returned one month later with the fistula healed, the congestion of the nose gone, no suppurative discharge and the antrum transilluminating much more clearly though not yet quite so well as the left.

Fig. 6.—Recurring nasal colds were cleared by removing these unsuspected abscessed second bicuspids, which were constantly draining a little infection into the antrums.

Figure 7

Figure 8

Fig. 7.—A recurring acute suppurative antrum was permanently cleared by sacrificing this useful well filled first molar. No abscess is apparent in the film.

Fig. 8.—There was no external evidence of this root other than a slight local shadow on transillumination. Its removal cleared the sinus infection and the headaches during the time that the patient was under observation.

Fig. 9.—A bilateral radical antrotomy and ethmoidectomy had been well done. The nasal polypi and asthma had returned. Both these dead second bicuspids were removed. The symptoms cleared without other operative treatment. It may be noted how the diseased tooth roots reach the antral floor, though no definite abscess shows, as the infection has escaped into the antrums.

COMMENT

Each patient came to the office for an infection of the antrum. Each patient supposed the teeth to be all right. In each case the dental transilluminator revealed, just under the floor of the diseased antrum, a tooth which appeared to be infected. In each case, the x-ray film showed the tooth to be abscessed. In three of the four, an alveolar fistula followed the careful dental extraction. At the time of writing, three were completely healed and the fourth was clearing, under little or no other treatment than the dental extractions.

CONCLUSION

In conclusion, I would impress on the Fellows of this association the ease and accuracy with which the teeth can be checked by transillumination and the considerable help that may accrue from the elimination of any dental infection in the floor of the diseased antrum. My arbitrary estimate of 60 per cent is not offered as proof of the exact incidence of dental caries in maxillary sinusitis in adults, but as an indication of the imperative need of reviewing the dental pathology in all recurring or chronic nasal and sinus infections. Many carefully assembled papers have been presented to help us in our endeavor to control these sinus conditions. It is only recently, since the science of dentistry has become so much more refined and since roentgenology has been more carefully applied to dental pathology, that this suspected connection between teeth and sinuses has been possible of exact demonstration. Members of this association have pleaded for broad specialization. I am adding my plea to that of the others. Dental apical infections are repeatedly affecting our cases. The careful rhinologist must consider gross dental pathology.

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ENDOCRINE FEATURES OF INTEREST TO THE OTOLARYNGOLOGIST *

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When this topic was first suggested, some doubt arose in my mind as to the advisability of its presentation, but on further consideration it seemed evident that since the endocrine glands constitute an important system of the body, especially in its development, its growth and in the co-ordination of its activities, they must affect all parts of the body and should be of interest in each of the medical and surgical specialties.

It seems possible that in the daily work of the otolaryngologist the idea of an endocrinopathy may rarely obtrude itself, while the internist with his interest directed chiefly toward the general condition of the patient must keep it in mind constantly. It is true that the otolaryngologist is frequently called on for help by physicians and general surgeons in the diagnosis and treatment of definite endocrinopathies, and he should have a working knowledge of the more important endocrine syndromes and especially concerning the way in which the structures in his particular field may be affected by them. If I should be engaged chiefly in carrying coals to Newcastle, I hope that there may be some nuggets of value amid the general dross.

One may consider the relationships of the endocrine glands to the domain of otolaryngology from the standpoint of:

(1) Physical juxtaposition and the possible results thereof. Thus, the thyroid, the hypophysis and the thymus are in close physical relationship with the structures of the otolaryngologist's special field. They may react on each other and may be affected by the same external agents.

(2) The influence of variations in the hormonal activity of the endocrine glands on the nose, throat, larynx and ears.

(3) The effect of otolaryngologic diseases on the endocrine organs.

It is convenient to take up each of the important endocrine glands in turn and to consider under each one the various relationships mentioned.

THYROID GLAND

The thyroid occupies first place in any general consideration of the endocrine glands. Its intimate physical association with the larynx

* Submitted for publication, Sept. 26, 1929.

* Read before the Oto-Laryngological Section of the Baltimore City Medical Society, March 8, 1929.

* From the Medical Clinic of Drs. Barker, Cross and Sprunt, 1035 North Calvert Street.

and trachea and its embryologic relationship to the pharynx and tongue make it a matter of prime interest to the otolaryngologist.

Simple Goiter.—By simple goiter is meant, of course, an enlargement of the thyroid gland without definite evidence of toxicity. It is harmful to the patient chiefly from the pressure exerted on adjacent structures and from the cosmetic standpoint. The pressure exerted by the goiter may be in relation to its size, but a small goiter unfavorably placed may exert far more dangerous pressure than a larger one situated elsewhere. In its enlargement the thyroid may grow in different directions—upward, lateralward, forward over the chest and frequently downward beneath the sternum. More interesting just now are the retrosternal goiters and the particularly dangerous and relatively rare circular goiter that grows entirely around the trachea.

Dyspnea is an early symptom of obstruction and, according to Rienhoff,[1] may appear before the goiter has been recognized. An accompanying tracheal catarrh may roughen the voice and cause occasional coughing and clearing of the throat. Nodular goiter more frequently produces displacement of the trachea, larynx and esophagus than does the diffuse type of enlargement. Rose found that under the pressure exerted by goiters the cartilaginous rings of the trachea undergo degeneration as a result of which the trachea becomes soft and may collapse, causing sudden and fatal asphyxiation. Below the seat of obstruction the trachea is often dilated.

Aberrant Goiter.—The thyroid is developed from a median pouch in the primitive pharynx, and in its migration between the third and eighth week of development it finally occupies its normal position in the neck, having traveled along what is later called the thyroglossal tract. Fragments of the developing thyroid or cells capable of developing into thyroid tissue may be deposited along this tract, and it is here that aberrant thyroids are more prone to develop. They occur also, however, in the mediastinum, in the pharynx, in the larynx, in the bronchi and in the esophagus as well as in the posterior triangles of the neck and the supraclavicular spaces. Normally, of course, these cell rests do not develop into thyroid tissue, but in the absence of the normal development of the thyroid gland there may be a compensatory enlargement of this aberrant thyroid tissue, so that not infrequently the aberrant thyroid is the only actively functioning tissue present, and its removal results in myxedema.

Although the thyroid gland in all stages of its development consists of a closed system of tubes and never empties into a duct, there is, nevertheless, a ductlike structure that forms along the thyroglossal tract.

1. Rienhoff, W. F., Jr.: Diseases of the Thyroid Gland, in Practice of Surgery, Dean Lewis, editor, Hagerstown, Md., 1929.

It is spoken of as the thyroglossal duct. Remnants of this structure may be discovered anywhere from the foramen cecum down through the hyoid bone to the region of the thyroid gland. As a rule, such remnants are not more than 1 cm. long. They may be lined by squamous epithelium or by ciliated columnar epithelium and may have lateral outgrowths. Cysts develop at times from these embryologic remnants and may be present in the midline of the neck, immediately below the hyoid bone, as tense, inelastic, firm bodies. They may be suprahyoid. Occasionally, thyroid rests are associated with them, and in the absence of normal development of the thyroid these rests may give rise to functioning thyroid tissue or a real aberrant thyroid. Apparently, these thyroglossal cysts are rather troublesome structures for the surgeon, and their cure is said to necessitate a complete removal of the thyroglossal tract, usually including a portion of the hyoid bone.

The points of interest in the diagnosis of an aberrant goiter are the midline position of the tumor and the absence of a normal thyroid gland. The symptoms to which it gives rise are usually mechanical in nature and depend largely on the position of the tumor. Dyspnea and dysphagia are common symptoms. Unfortunately, the diagnosis is often not made until operation, and it is not always advisable that the tumor be disturbed unless it is giving rise to marked symptoms. In many cases the removal of the aberrant thyroid results in myxedema. The administration of small doses of iodine at several periods during the year may suffice in preventing the tumor from growing to an embarrassing size.

Exophthalmic Goiter.—This type of goiter with its striking effect on the general metabolism, on the cardiovascular system and on the nervous system forms a dramatic clinical picture and will be rarely overlooked in a fully developed case. The symptoms that may develop in the otolaryngologist's particular sphere of activity include cough, subjective feelings of dyspnea, markedly irregular breathing and occasionally bronchorrhea. There may be, too, a feeling of fulness with throbbing in the ears, transient or occasionally persistent deafness, tinnitus or marked vertigo.

A feature of considerable controversial interest is the possible relationship of infections, including those in the nose and throat, to the onset of exophthalmic goiter. While it is generally considered now that there is an important underlying constitutional factor, the possible exciting causes of the disease range over a rather wide zone; among them, focal infections are prominently championed. There are reports in the recent literature of the prompt subsidence of symptoms of the disease following the removal of infected tonsils and there are, on the other hand, reports of the fulminant onset of the disease shortly after surgical procedures on the nose and throat. As a rule, I advise a subtotal

thyroidectomy in all cases in which the disease is well marked, and later removal of infected tonsils and other possible sources of infection. In milder cases it may seem wiser to remove the foci of infection first and to note the effect of the removal before advising an operation on the thyroid gland.

Symptoms of pressure may arise from the goiter in this disease just as from a simple goiter, particularly in cases of long duration that have shown many exacerbations and remissions.

Hypothyroidism.—In cases of hypothyroidism the thyroid gland may be quite small, or, on the other hand, there may be a goiter. The clinical picture of hypothyroidsm is less dramatic than that of hyperthyroidism and is apparently much more often overlooked. Publications from the Mayo Clinic indicate that most of their patients with hypothyroidism have not been recognized as having this condition before coming to the clinic.

There is characteristically a dryness of the mouth and a large tongue. In children the defective development of the bones of the face may result in narrow nasal passages. Snoring may be one of the early signs. There is often a chronic rhinitis, and a tendency to respiratory infection may be the feature that first brings the patient to the physician. Respirations are slow. Asthmatic attacks occur. There may be dulness of hearing and even marked deafness, the underlying basis of which is somewhat obscure. In some cases it is thought that a myxedematous condition of the mucous membranes of the ear may be present. Often it is more a psychic deafness than one due to any real structural changes in the organs of hearing.

In marked cases the myxedema involves the mucous membranes as well as the skin and may produce striking pictures in the nose, throat and larynx. In the recent literature there are a number of papers descriptive of such lesions in the larynx, pharynx and mouth. Mann [2] described the case of a woman, aged 25, who had been well except that in the past few years she had had frequent tonsillar abscesses. Six weeks after a tonsillectomy, dyspnea, pains in the neck and difficulty in swallowing developed. There were other complaints of headache, nausea, anorexia and cramplike pains in the heart. On examination there was found a marked pale edema of the entrance to the larynx, the epiglottis and the aryepiglottic folds, infiltration of the laryngeal cartilages and a purulent secretion. The vocal cords were said to be normal. The tongue was smooth, the soft palate very stiff and the uvula small and edematous. The epiglottis was much thickened, and its shape changed as if pressed together. The entrance into the larynx was much narrowed. The lingual tonsils appeared as thick, pale yellow,

2. Mann: Seltene Kehlkopferkung mit eigentümlichem klinischen Verlauf, Ztschr. f. Hals-, Nasen- u. Ohrenh. **21**:369 (May 10) 1928.

hard tumors. The author further described the general symptoms of the marked hypothyroidism and reported that within two weeks after thyroid treatment was begun there was a marked subjective improvement; there was also marked objective improvement on examination of the upper air passages.

Adam [3] reported three somewhat similar cases and stated that a so-called laryngitis that lasted for months and left the true cords practically unchanged in appearance was presumably myxedematous. He said that the back of the larynx looked like a beefy red shield, and that the pale, anemic appearance described in some textbooks was not apparent in his cases.

The diagnosis in hypothyroidism is most important. As I have indicated, the otolaryngologist may have the first opportunity to make it. The result of proper treatment by thyroid feeding is strikingly beneficial; without this proper treatment, improvement need not be expected or may be long delayed. As I have said, the diagnosis is often overlooked. Features that should lead the physician to suspect the possibility of hypothyroidism are:

(1) In children
  (*a*) Retarded growth
  (*b*) Habitual constipation
  (*c*) Dulness at school

(2) In adults
  (*a*) Persistent constipation
  (*b*) Endogenous obesity
  (*c*) Dry, harsh skin
  (*d*) Subjective feelings of cold
  (*e*) Recurring drowsiness during the day.

When any of these features are present, the basal metabolic rate should be determined and, if retarded, thyroid treatment should be instituted.

Cretinism.—Endemic cretinism fortunately does not occur in this locality, but occasionally a sporadic cretin is observed. In goitrous districts endemic cretinism is, of course, important. Wherever endemic cretinism flourishes, endemic deaf-mutism is found; these conditions are considered to be the manifestations of the one disease, cretinic degeneration. The ratio in Switzerland is said to be five cretins to four deaf-mutes. Apparently deaf-mutism may be practically the only evidence of the disease, or it may be associated with hypothyroid symptoms.

The pathogenesis of the deafness in these cases is a highly controversial point. A number of alterations in the peripheral hearing

3. Adam, J.: Laryngeal Myxoedema, Brit. M. J. **1**:594 (April 7) 1928.

apparatus have been described: incomplete ossification of the stapes, defective development of the epithelial cells of the cochlea, anomalies of the malleus and myxedematous thickening of the tympanic mucous membrane. Other students of the condition ascribe the greatest importance to the degeneration in the cortical centers, or rather, perhaps, to the developmental defects in these centers.

Effect on the Recurrent Laryngeal Nerves.—In persons with goiters the laryngeal disturbance due to partial or complete paralysis of the recurrent laryngeal nerve [1] may result from:

(1) Direct pressure of the goiter on the recurrent nerve
(2) Injury during operation—
  (*a*) Direct trauma by clamping, cutting or ligating the nerve
  (*b*) Indirect trauma by stretching and pulling on the nerve in manipulation of the gland
(3) Postoperative hemorrhage or oozing causing pressure on the nerve
(4) Inflammation or scar tissue formation after an operation involving the nerve

Since the symptoms are not always indicative of the state of the muscles controlling the vocal cords, surgeons who perform operations on the thyroid gland are usually careful to have routine laryngologic examinations made both before and after operative procedures.

Following their experimental work, Judd, New and Mann [4] concluded:

1. Section of the recurrent laryngeal nerve produces complete paralysis of the vocal cord of the corresponding side, which in all probability will be permanent.

2. Ligation of the recurrent laryngeal nerve with linen, chromic catgut or plain catgut produces complete and probably permanent paralysis of the vocal cord of the corresponding side.

3. Stretching the recurrent nerves acutely in a manner that is similar but of longer duration and intensity than that in operation does not impair the function of the vocal cord.

4. Stretching the recurrent laryngeal nerves for a long period, as over muscles, impairs the function of the vocal cords, but the impairment is probably due to the operative trauma and not to the stretching.

5. Pinching the recurrent laryngeal nerves with a hemostat in a manner similar to that which may occur in an operation produces temporary paralysis of the vocal cords. Restoration of function always occurs, the length of time necessary for restoration depending on the anatomic point at which the nerve is crushed. The time found necessary for complete regeneration of the nerve, when injured in the area usually traumatized by operation, is between thirty and sixty days.

6. Exploration of the recurrent laryngeal nerve produces an effect on the vocal cords, depending on the amount of trauma to which the nerves are subjected. Careful dissection will probably not produce any effect.

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4. Judd, New and Mann, quoted by McNerthney, J. B.: Laryngeal Paralysis and Thyroid Surgery, Northwest. Med. **27**:326 (July) 1928.

Indirect Relationships.—Certain indirect relationships may be of some interest to the otolaryngologist.

Within the past year, Owen, Cope and Hill [5] called attention to an unsatisfactory test of the basal metabolic rate that they considered the result of perforated ear drums. While it was not proved beyond a doubt, they thought the evidence very suggestive. In their case several unsatisfactory tests indicated leakage, but no other source of leakage was found except the perforated drum. The reading had shown minus 36 per cent. They stopped up the ears, and other readings were quite satisfactory; the rate was found to be normal. Their tracings showed breaks suggestive of the time of swallowing movements. One might well be on the lookout for such instances and see whether their observations can be confirmed.

A few months ago there appeared a report by Kilduffe [6] of necrosis of the larynx as a possible complication of the treatment of goiter by irradiation. In his case the irradiation had occurred five years before and with good effect on the exophthalmic goiter. The patient, a woman aged 32, appeared for treatment on Sept. 16, 1927, for some minor ailment. The hemoglobin was 85 per cent; the white blood cells, 14,000, and the polymorphonuclear leukocytes, 73 per cent. Two months later, on November 17, the patient came again, complaining of headaches, and soreness of the neck and throat; the temperature was 101 F. The next day there were hoarseness and difficulty in swallowing. She was prostrated and toxic. No diphtheria or Vincent's organisms were found. The white blood cells were 1100, and the polymorphonuclear neutrophils 40 per cent. A laryngologist in consultation found no lesion. The next day another laryngologist found gangrene of the arytenoid cartilages. The patient died, and an autopsy was held one hour after death. The thyroid was found to be shrunken. The larynx showed gangrene of the cords and adjacent tissues and of the contiguous portion of the base of the tongue. The odor was quite foul. There was a mixed bacterial flora. The author stated his belief that the irradiation was at least a contributory factor. He cited Clerf's report of a similar case occurring five years after roentgen treatment, and another occurring nine years after such treatment. Iglauer reported a case and collected twenty others, and Clerf added six more to the literature.

PARATHYROID GLANDS

When the parathyroid glands are completely removed there occurs a condition spoken of as tetany—tetania parathyreopriva—in which

5. Owen, Cope and Hill: Unsatisfactory Test of Basal Metabolic Rate as Result of Perforated Ear Drum, J. A. M. A. **90**:1442 (May 5) 1928.

6. Kilduffe, R. A.: Necrosis of Larynx as Possible Complication of Treatment of Goitre by Irradiation, Arch. Otolaryng. **8**:185 (Aug.) 1928.

there are: hyperexcitability of the motor nerves, with a tendency to develop certain hyperkinetic phenomena; disturbances of the sensory nerves, with paresthesias, etc.; certain metabolic disorders, notably diminution in the calcium of the blood, changes in the intermediary protein metabolism and changes in the acid base equilibrium of the body.

Besides the tetania parathyreopriva, there are other clinical types of tetany; for example, that occurring in children often in association with rickets, tetany accompanying certain diseases of the digestive apparatus—so-called tetania gastrica or tetania colonica—tetany occurring during pregnancy—tetania gravidarum—and the so-called tetania idiopathica of workmen in certain trades in central Europe. By analogy with the tetany following the removal of the parathyroid glands there has grown up the doctrine of unity in the conception of tetany, attributing all types of cases to the abolition of or to an insufficiency of the function of the parathyroids. This idea, however, is not by any means universally accepted.

While the carpopedal spasms are especially characteristic, the spasmodic phenomena may involve a great many of the muscular structures of the body. Laryngeal spasm is one of the common symptoms of tetany in childhood and may be the only spontaneous chronic spasm exhibited. As many of these children have rickets, there is often a dispute as to whether the laryngeal spasm is due to rickets, to tetany or, perhaps, to some organic disease of the nervous system. The diagnosis of tetany may be made by the demonstration of an increased electrical excitability of the motor nerves or may be aided by demonstrating a positive Chvostek sign, contraction of the facial muscles following tapping on the facial nerve, or a positive Trousseau sign, the production of a carpal spasm by maintaining pressure on the upper arm for several minutes. The pressure should just exceed that sufficient to obliterate the pulse.

HYPOPHYSIS CEREBRI

The hypophysis, in its sella turcica, is in close physical association with the sphenoidal sinus. The nasosphenoidal route has been used in the surgical approach to the sella and to the hypophysis. Occasionally a hypophyseal tumor erodes the floor of the sella and extends into the sphenoidal sinus.

The hypophysis is a complex structure with an anterior epithelial portion and a posterior nervous portion. The anterior lobe is developed from an ectodermal pouch, called the pouch of Rathke, which grows upward under the brain from the stomodeal epithelium. In later development, Rathke's pouch is divided into different portions, and from the cranial part there are developed the pars anteria propria, the pars inter-

media and the pars tuberalis. There are sometimes small accessory hypophyses which are also situated in the sella turcica. From the pharyngeal portion of Rathke's pouch there develops the so-called hypophysis pharyngei, situated in the middle line near the junction of the nasal septum and the roof of the pharynx; in the adult, it measures about 5 by 1 mm. The tissue presents all the histologic features of the anterior lobe of the hypophysis. According to Lewis, it is to be regarded as an actively functioning gland rather than as a rudimentary or involuting one. Tumors analogous to the aberrant thyroid glands have been described. Erdheim found one in the sphenoidal sinus in a patient who had acromegaly. The hypophysis was in its usual position in the sella turcica and was normal in appearance. A few tumors have been found in the roof of the pharynx, having a histologic picture similar to that of the anterior lobe of the hypophysis.

Acromegaly.—An important function of the anterior lobe of the hypophysis is a stimulating effect on growth. This is shown in the outstanding disease of this portion, acromegaly, and also by the experiments of Evans [7] and his co-workers who were able to produce gigantism in rats by injecting sterile protein-free extract of the anterior lobe. Hyperplasia or adenomas of the chromophil cells of the anterior lobe are associated with acromegaly. Adenomas of the chromophobe cells, on the other hand, do not produce acromegaly but show merely the signs and symptoms of hypophyseal tumor, together perhaps with some of the features that suggest a lack of secretion of the hypophysis. It is from the posterior lobe, derived from the nervous system and from the thin intermediary portion, that the active principle (pituitrin, hypophysin, pituitary liquid) used as a pharmaceutic agent is derived.

Acromegaly, an interesting disease, is fortunately rare. It is chronic, usually beginning in the third decade and characterized by a marked bony overgrowth involving the facial portion of the skull, the hands, the feet and all the bones in the body. There is an associated hypertrophy of the soft parts, with marked coarseness of the features to the point of deformity. Later in the disease there are hypertrophy of the internal organs, signs and symptoms of the pituitary tumor, asthenia, paresthesia, often severe pain, and frequently a widespread disturbance of the other endocrine glands. Goiters, with their possible effects of pressure, are not unusual.

Among the early symptoms are headaches, pain in the face and paresthesias in the head and face. Mark,[8] who wrote an autobiography

7. Evans, H. M.: The Function of the Anterior Hypophysis, in Harvey Lectures, Philadelphia, J. B. Lippincott Company, 1923-1924, p. 212.

8. Mark, Leonard P.: Acromegaly: A Personal Experience, London, Ballière, Tindall & Cox, 1912, p. 160.

of a patient with acromegaly, described the sensation as if the face were in a vise, the antrum tightly packed, the teeth too large for their sockets and the eyes pressed on.

Chevalier Jackson [9] gave a description of the laryngoscopic appearance in four patients with acromegaly, one of whom required a tracheotomy for laryngeal stenosis. He said:

> External palpation of the larynx revealed it to be of enormous size, the enlargement seeming even and symmetrical. Laryngoscopic examination showed a general overgrowth of the larynx. The epiglottis, aryepiglottic folds, ventricular bands and vocal cords were proportionately enlarged. An appearance of asymmetry was given by the deviation of the long axis of the glottis which instead of being sagittal was deviated to the left posteriorly. The glottic chink was very narrow and was insufficient for breathing. The left aryepiglottic fold was as much thickened as the right but was not so long. The whole laryngeal image was strongly suggestive of the facies and ginger-bread hands of acromegaly.

This was the description of the case that required a tracheotomy. The changes in the other cases were similar.

The tonsils are often greatly enlarged in acromegaly, and there may be excessive lymphoid tissue in the pharynx. The frontal sinuses are deep, and there may be enlargement of the antrums. Curchod [10] recently reported a case of a patient with mild acromegaly who complained of nasal obstruction. There was marked hypertrophy of the turbinates and a diffuse edematous infiltration of the nasal mucosa that on histologic examination showed inflammatory elements, with edema and here and there a hyperplastic angiomatous proliferation.

In regard to the pharyngeal hypophysis, Beck [11] quoted Bryant as believing that chronic nasopharyngeal infections interfere with the pharyngeal pituitary function and that removal of the tonsils and adenoids, with relief from the infection, results in more rapid growth and improved nutrition.

STATUS LYMPHATICUS AND THE THYMUS

The recent review of this subject by Marine [12] in the *Archives of Pathology* will prove interesting, I am sure. I agree with him entirely in relegating the thymus, formerly given a centrol rôle in this picture,

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9. Jackson, C.: Acromegaly of the Larynx, J. A. M. A. **71**:1787 (Nov. 30) 1918.

10. Curchod, E.: De quelques altérations morphologiques rhinopharyngées en relation avec le syndrome hypophysaire, Schweiz. med. Wchnschr. **58**:537 (May 26) 1928.

11. Beck, Harvey G.: Dystrophia Adiposogenitalis, in Endocrinology and Metabolism, Barker, Hoskins and Mosenthal, editors, New York, D. Appleton & Company, 1922, p. 858.

12. Marine, D.: Status Lymphaticus, Arch. Path. **5**:661 (April) 1928.

into a decidedly secondary place. The function of the thymus is unknown but it resembles the lymphoid tissues closely. There is no proof that it has an internal secretion. Marine's definition is as follows:

> Status lymphaticus may be defined as a constitutional defect usually congenital, though it may be acquired, dependent on an inadequacy of some function of the suprarenals, sex glands and autonomic nervous system and associated with lowered resistance or increased susceptibility to a great variety of nonspecific physical and chemical agents. Anatomically it is characterized by delayed involution or hyperplasia of the thymus, hypertrophy and hyperplasia of the lymph glands and lymphoid tissue of various organs, underdevelopment of the chromaffin, gonadal (suprarenal cortex, interstitial cells of testes and ovaries) and cardiovascular systems and certain peculiarities of external configuration.

The otolaryngologist's interest in this connection is chiefly in the so-called thymic asthma and in the peculiarly lowered resistance of these patients with the greatly increased risk that the surgeon assumes when operating on them.

Unfortunately, there are no satisfactory criteria for the clinical recognition of such cases, especially in young children. The usual signs of a pale, thin, velvety skin, enlargement of the tonsils, superficial lymph glands and thymus, and lymphocytosis are not constant occurrences. Enlargement of the lymphoid follicles at the base of the tongue is said to be a constant sign in cases of status lymphaticus, though it may be present in other conditions. When the lingual follicles are enlarged, it would be wise to make a careful search for other signs.

The controversy concerning the cause of death in status lymphaticus and concerning the respiratory stridor also has been going on for many years. Marine cited the following theories: 1. Death is due to pressure of an enlarged thymus on the trachea, blood vessels and nerve trunk. 2. It is the result of the constitutional defect manifesting itself through an injurious raising of the vagus tone together with a deficiency of the chromaffin system and weakness of the sympathetic system. 3. It is a result of hypersusceptibility to physical and chemical agents. 4. It occurs through anaphylaxis. 5. It results from an abnormal thymus secretion of a general lymphotoxemia.

It seems to be acknowledged that occasionally tracheostenosis may be produced by an enlarged thymus as reported by Jackson and others in bronchoscopic examinations, but in the great majority of cases no evidence of pressure is found. The relief experienced from roentgen treatment is not necessarily proof of a thymic origin because: (1) the relief is sometimes too rapid, and (2) the benefit may be due to other and more distant effects of the roentgen rays. Another important bit of evidence against a thymic stridor or asthma is that the stridor may be present when the thymus is small, or absent when the thymus is large.

SUPRARENAL GLANDS

The suprarenal bodies are, like the hypophysis, divisible into two portions, different in structure, in embryologic development and in physiology. The cortical portion or the so-called interrenal tissue is closely related to the gonads, while the medullary portion is closely connected with the sympathetic nervous system. It is from the medulla of the suprarenals that the active pharmaceutic preparations are obtained. However important epinephrine may be to the otolaryngologist, it is evident from experimental work that the medullary portion of the suprarenals is not necessary to life. The removal of the cortex, on the other hand, is fatal.

The outstanding clinical syndrome associated with the suprarenal glands is Addison's disease, regarded as a result of a lesion of the gland as a whole. It is a chronic, progressive and fatal disease that is fortunately not common. Its chief features are marked asthenia, bronzing of the skin and mucous membranes, gastro-intestinal disturbances, very low blood pressure and perhaps a general vascular hypoplasia. The spleen is often enlarged, and the lymphatic structures are generally enlarged. There is usually anemia of the secondary type and lymphocytosis.

As already pointed out, there is a certain relationship between hypoplasia of the chromaffin tissues and status lymphaticus. It is now generally believed that a tuberculous or other lesion of the suprarenal glands that produces Addison's disease is prone to develop only in defective structures such as might be associated with status lymphaticus.

The chief interest of the otolaryngologist in Addison's disease lies in the pigmentation of the mucous membranes and in the features already pointed out for status lymphaticus.

Pigmentation of the mucous membranes that is almost constantly present is usually distributed in the form of small, bluish-black spots or streaks on the lips near the mucocutaneous junction, the border of the tongue, the buccal mucosa, the gums and the soft palate.

Patients with Addison's disease, as in status lymphaticus, show the peculiar lack of resistance or increased susceptibility to external agents that makes them poor surgical risks.

Lesions of the interrenal tissues or cortical portion of the suprarenal glands usually give rise to disturbances in the sexual sphere and, while interesting in themselves, are of no especial interest to the otolaryngologist.

GONADS

Here I refer to the partly fanciful, partly real association of the nasal mucosa with the gonads. In 1893, Fliess described a form of dysmenorrhea which he spoke of as nasal dysmenorrhea. Since then,

there have been many reports, but, as Novak [13] stated, the subject has not been investigated with the thoroughness or finality to which its interest and importance would seem to entitle it.

It is known that erectile tissue is found in the nose as in the genital tract. In the nose it is found especially at the anterior end of the inferior turbinated bone and in a small circumscribed area known as the tuberculum of the nose. These are the two areas that Fliess designated as the genital spots. According to Fliess, these spots are always swollen and congested during menstruation. Fliess believed that by his test of the application of 20 per cent solution of cocaine to the genital spots of the nose, he could decide whether or not further nasal treatment would relieve the dysmenorrhea. The treatment was given by applying the cocaine four different times at intervals during the menstrual cycle. After this test had proved positive, trichloracetic acid was sometimes substituted for the cocaine.

Another author, Schiff, convinced himself further that the application of cocaine to the anterior end of the inferior turbinate caused the disappearance of pain in the hypochondrium, while a similar application to the tuberculum of the septum controlled the backache. Other authors who could confirm in a measure the beneficial results of such treatment emphasized the need of caution in interpreting these results and are inclined to stress the psychic factors as well as the general effect of the cocaine after absorption into the circulation. I would refer those who are particularly interested in this subject to Novak's monograph on "Menstruation and Its Disorders."

Another matter of controversial interest is the subject of vicarious menstruation. Certain important authorities would deny that there is such a phenomenon. Others deplore the fact that it has in the past been so strongly emphasized. Novak states that authentic reports of vicarious menstruation are now so numerous that there can be no question as to its occurrence. It must still, however, be regarded as an uncommon phenomenon. Epistaxis seems to be the most frequent form taken by the vicarious menstrual bleeding. A hemorrhage from the nose may be slight or profuse and may continue intermittently throughout the normal menstrual period. Bleeding from almost all parts of the body have been listed under this heading. There is a recent report [14] in the literature of a young woman with pulmonary tuberculosis who had a brisk hemoptysis during the menstrual period for seven successive periods, and showed absolutely no blood in the sputum at any other time in the menstrual cycle. The diagnosis of vicarious menstrual

13. Novak, Emil: Menstruation and Its Disorders, New York, D. Appleton & Company, 1921.

14. Chapman, R. S.: Unusual Type of Vicarious Menstruation, Brit. M. J. 1:1065 (June 23) 1928.

bleeding should never be made, of course, unless it is satisfactorily demonstrated that the bleeding occurs at the time of menstruation during a number of menstrual periods and at no other time.

PANCREAS

I wish to point out here the reciprocal relationship existing between infections in general and the glandular disorder responsible for the development of diabetes.

Although it is not certain that focal infections or acute infectious processes are important exciting causes of diabetes, one does feel sure that diabetes is made worse by such infections. Hence the internist has the greatest interest in having focal infections in his patients treated with great care and eradicated as far as possible.

Conversely, the otolaryngologist not infrequently needs the services of the internist in treating such patients. Infections in the nose and throat, as well as otitis media and mastoiditis, may cause a great deal of trouble in patients with diabetes and then may heal promptly with the institution of the proper dietetic regimen and the correct use of insulin.

OTOSCLEROSIS

In almost all of the special fields of medicine there are certain conditions the etiology of which is obscure and about which many opinions are expressed. In such discussions the endocrine glands, as might be expected, often play an important part. I take it that in otolaryngology otosclerosis would fill this rôle acceptably.

Various authors have noted the features suggestive of an endocrine disturbance in otosclerosis. They have pointed out the hereditary tendency, that it occurs especially in females and that it is apt to be worse at the stages of puberty, pregnancy and the climacteric. They have cited the vasomotor signs and symptoms, in combination in some cases with blue sclerae, fragility of the bones and diminished calcium in the blood. The basal metabolic rate, in the opinion of some observers, is usually reduced; in the opinion of others, it is usually accelerated. The hypophysis, the thyroid, the gonads and other glands are incriminated by different students of the disease. Montgomery,[15] in a recent review, quoted Drury to the effect that in one third of the cases there is no evidence of an endocrinopathy, but that various endocrinopathies occur in two thirds of the cases. He believes that the endocrine disturbances might be a factor in the development of otosclerosis, but that underlying them there must be the diathesis toward its development.

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15. Montgomery, R. R.: Ostosclerosis: Review of Literature, Arch. Otolaryng. **7**:321 (April) 1928.

It would seem to me that there are many analogies to this situation in other fields of medicine; that the probable explanation of otosclerosis lies in a congenital inferiority of the auditory apparatus; that frequently there is associated with it a congenital inferiority of the endocrine system, and that there is no necessity or justification for assigning to the endocrinopathy an etiologic rôle in the development of the otosclerosis.

DEAFNESS AND COINCIDENT VARIATIONS IN NASAL AND IN AURAL PATHOLOGY*

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NEW YORK

In health and in disease, acuity of hearing may vary from time to time, even from hour to hour, up and down, depending on factors many of which are unknown, but clinical experience warrants the conclusion that marked variations in the degree of deafness are fundamental signs of a changing condition in the ear, and they have been so interpreted in this study, irrespective of the otoscopic picture. The majority of diseases of the ear, like the majority of most diseases, are self-limited processes which tend to resolution and restoration of function. There are, however, many lesions which from their incipiency seem chronic. Though medical science has found few cures for these, it must constantly strive to solve the mysteries of their being. A considerable number of apparently chronic inflammations are associated with disease in other parts of the organism, contiguous or remote. Such are chronic disease of the organs of special sense, preeminently of the ear.

In searching for the causes of deafness, it is apparent, then, that attention should be directed to many tissues outside of the ear, and that though the disease of the ear may be directly responsible for the complications and deafness, both of these may ultimately prove to be primarily dependent on lesions located at some distance from the ear. For instance, such conditions as focal infections, disease in the nose, throat, chest and abdominal organs, and metabolic dyscracias, etc. may be the cause of disease of the ear. On the other hand, furuncles, exostoses, nerve degeneration, and inflammations of the mastoid cells and contiguous structures, though directly caused by a disease of the ear, may be dependent primarily on lesions that had set up the prior inflammation in the ear.

Diseases of the ear frequently occur coincidentally with nasal inflammations, and yet commonly they appear to occur independently of nasal disease. The thought occurred that the reason no nasal disease was discernible in many instances was that it had not been properly looked for; for several years, therefore, a search has been made, not only with the naked eye, but with the aid of special technic and stereoscopic roentgenology.

* Submitted for publication, Aug. 30, 1929.

A year ago, before the American Laryngological, Rhinological and Otological Society, there were reported the observations in 100 consecutive cases of disease of the ear in children; 86 per cent of these patients showed definite disease of the sinus, and all showed some symptoms of sinus disease. Depending on the group, the disease, as shown by x-rays, varied to such an extent that it was thought advisable to continue these studies until a sufficient number of cases were tabulated to establish the conculsions more definitely. During the past year, about 300 cases have been observed, and it may be stated that in general the results correspond with those obtained last year. Further particulars will be published later regarding these observations.

At this time, a report will be made on the variations found in nasal and aural disease coincident with variations in hearing. It is possible to do this because the scheme devised last year was carried out. This was to make repeatedly complete clinical, otoscopic, audiometric and roentgen examinations. It has been held that there is no use in treating the chronically deafened patient (once deafened, always deafened). For the adult there is much truth in this, but for the child there is much error, because careful measurements have shown marked improvement in 25 per cent of the present series of deafened children, and definite improvement in 50 per cent. This is a low estimate, because patients often fail to return for retesting.

All cases of deafness were placed in four age groups: from 1 to 9, from 10 to 15, from 16 to 21, inclusively, and over 21 years. When the data on several hundred cases in each disease group have been collected and compared with data on a large number of persons with normal hearing, it is hoped that information of value will be obtained from this method.

What is chronic deafness? How long must one be deafened before the condition may be called chronic? The children and most of the adults observed had chronic deafness in the accepted definition of the term; that is, they had been deafened for several years, and no likelihood of improvement or cure seemed probable. Of the patients who showed improvement, some maintained this improvement and some did not. From both classes much was learned concerning the cause of the deafness, because the patients were examined soon after an improvement in hearing and soon after a relapse, and following both conditions the changes in aural and sinus disease were noted. In some instances, no change was detected, but in this case there had usually been a delay of a few weeks between the change in hearing and the taking of the films. This delay was sufficient to permit recurrence of or recovery from the sinus disease and the inflammation in the ear. In other words, the condition changed between the test for hearing and the presentation of the patient for roentgen examination.

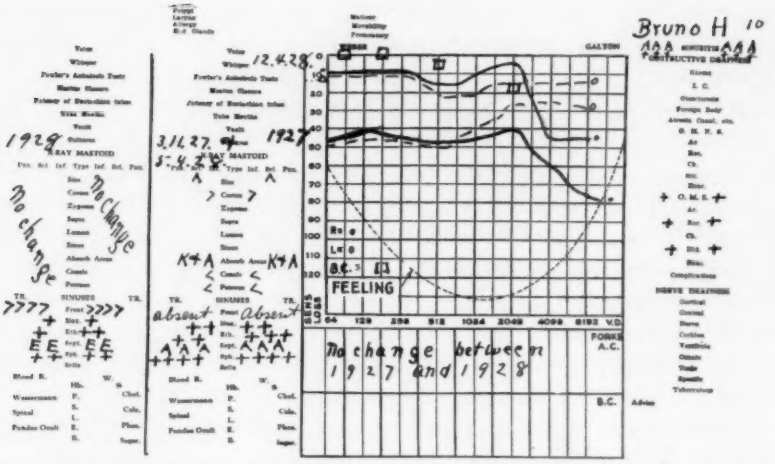

Chart 1 (Bruno H.).—The later plates showed a decrease in the opacity of both antrums and a slight change in the appearance of the septums. The latter showed the apparent absorption changing to two degrees of edema. The appearance of absorption in the ethmoid septums disappeared with the lessening exudate, and the cell walls showed distinctly their true likeness, which was two degrees of edema. The hearing increased in a spectacular manner in both ears, but it was not a sudden improvement. There was no change shown in the plates of the mastoids between 1927 and 1928.

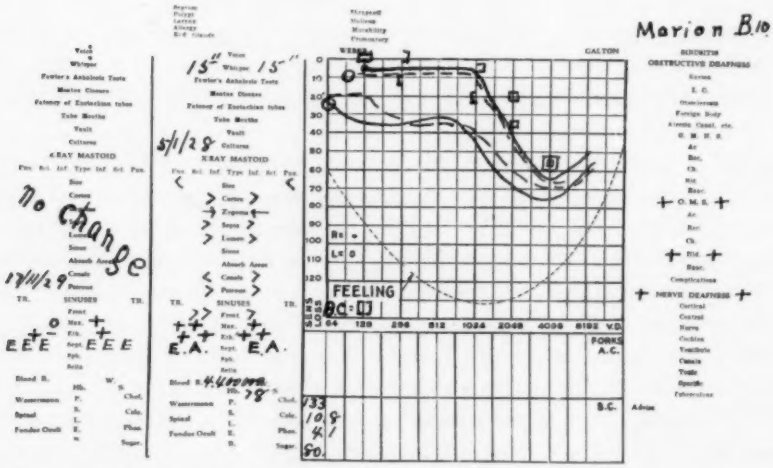

Chart 2 (Marion B).—This was a case of combined nerve and obstructive deafness. The later plates showed less opacity in the ethmoids, especially on the right, and the cell walls appeared a trifle clearer, especially posteriorly, in spite of the edema. There was less opacity in the antrums, especially on the right. The hearing improved greatly in the lower half of the frequency scale. In the upper tones it improved progressively less until little change occurred above 4,000 double vibrations.

One cannot catch every change in the disease picture unless the patient is constantly under observation. However, if with definite changes in the function and the picture of a diseased organ, there occur repeatedly coincident changes in the function and the picture of a closely related organ, little doubt remains but that the diseases in the two organs are correlated. The important thing is to be certain that the observations as to function and picture are accurate. Careful audiometric examination establishes accuracy of the functional state. Careful clinical examination and stereoscopic roentgenograms interpreted by an expert establishes accuracy of the disease picture.

The ethmoid cells were selected for careful study, because it was noted that although the nasal sinus spaces might show no involvement,

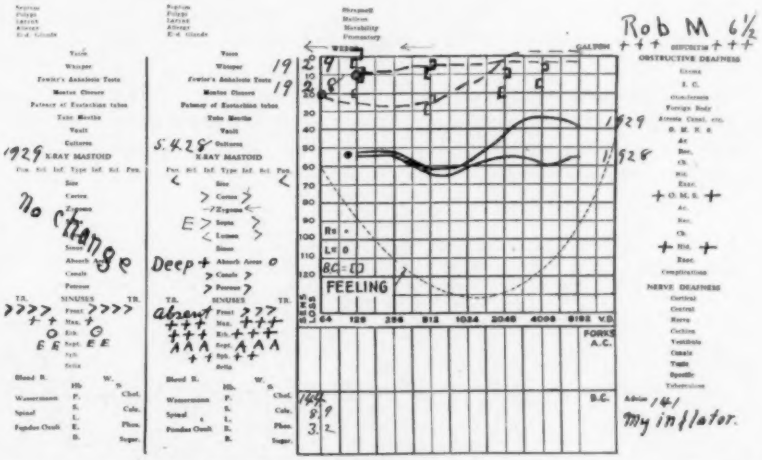

Chart 3 (Robert M).—This was a case of obstructive deafness. The later plates showed a marked decrease in the opacity of the antrums. The ethmoids cleared and the septums became visible. The septums were originally nonvisible in this case, probably because of the masking by the exudate. When this cleared up, the septums not only reappeared but looked edematous on both sides. The right ear improved for the high notes, and the left ear for the low notes. The latter ear returned to almost normal at all frequencies.

distinct disease could often be detected in the ethmoid septums. This condition consists in varying degrees of absorption, condensing osteitis and edema of the bony walls.

By absorption is meant the disappearance of the lime salts from the bone. Depending on the degree to which this occurs, the roentgen rays will be less and less impeded and the plates will show less and less shadow of the ethmoid septums i. e., in the accompanying charts, *A* indicates slight absorption of the calcium from the bone; *AA*, moderate absorption; *AAA*, marked absorption, and *AAAA*, extreme

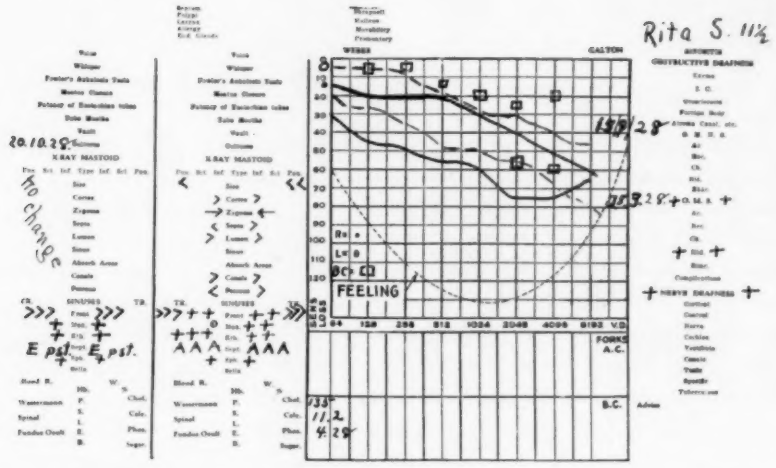

Chart 4 (Rita S.).—This was a case of combined nerve and obstructive deafness. The later plates showed a marked decrease in the opacity of the ethmoids, more especially on the right side, also in the antrums, especially on the left. The ethmoid septums appeared much clearer and showed but little edema. It is probable that the large degree of absorption in the septums shown in 1928 was not a true picture, because the cell walls were masked by the exudate in the cells; when this cleared up, they reappeared. The hearing increased about 25 per cent in the right ear, and 20 per cent in the left ear. The bone conduction still remained progressively lowered as frequency increased.

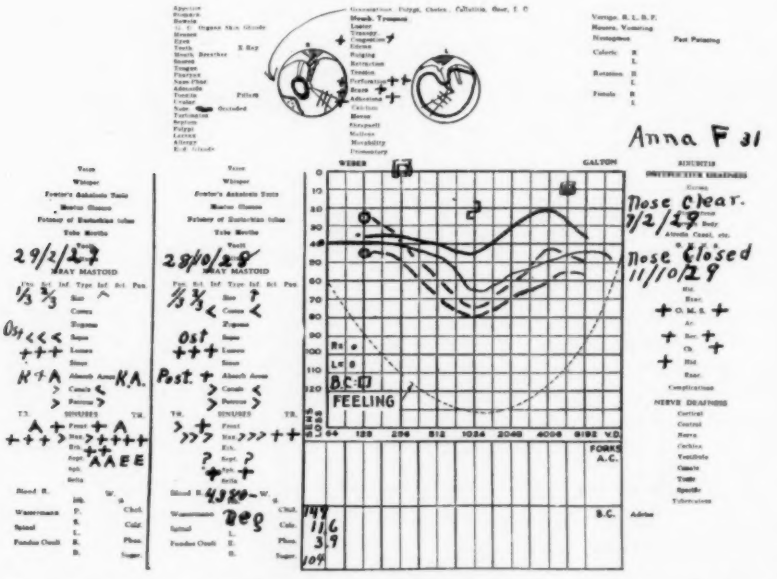

Chart 5 (Anna F.).—This was a case of recurrent and progressive deafness in the adult. The later plates showed a marked opacity in the right and left antrums. The left ethmoids showed an increase in the opacity and in the amount of edema in the septums. The cell walls did not show as clearly, probably due to an acute process. No roentgenogram was taken until several weeks after the hearing test on Feb. 7, 1929. In the meantime, the patient had caught another cold and the hearing in the right ear relapsed to its former level. Note that the 1928 roentgenogram was not taken until eighteen days after the audiogram. (In the right hand column of observations the date 11/10/29 should read 11/10/28.)

absorption. In other words, the picture in extreme absorption is similar to that obtained after complete operative evisceration of the ethmoid labyrinth. Exudates within the cells may obscure or mask the cell walls and give a false picture of their absorption. In such cases, the walls reappear with the subsidence of the edema.

By condensing osteitis (*Co*) is meant a shrinking of the septums, a terminal stage of inflammation of the bone, wherein the shadow of the bony wall is thinned and intensified because of the relatively larger proportion of lime salts. This stage may go on to a sclerosis.

By edema is meant a swelling of the bone. This occurs in early stages of osteitis and in circulatory stasis. In the roentgenograms, the

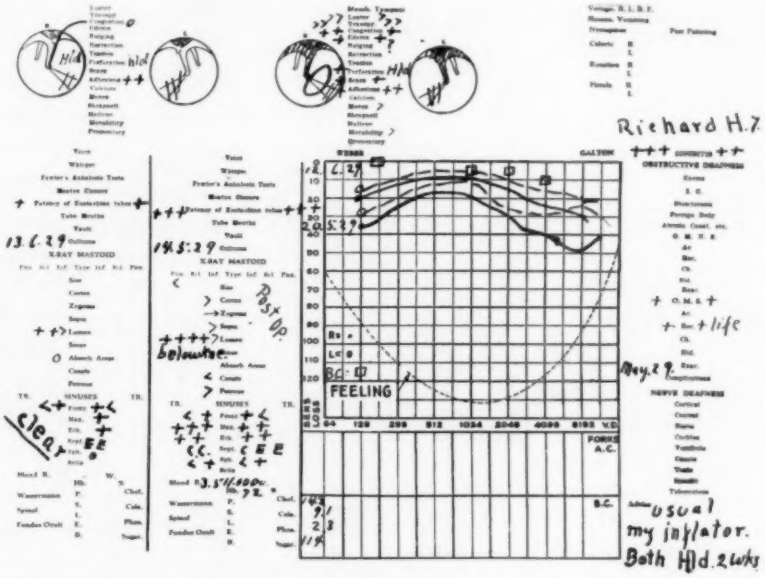

Chart 6 (Richard H.).—This was a case of recurrent suppuration, in which the patient was tested several weeks after the third mastoid operation on the left ear and a resolving acute inflammation in the right ear. No attention had been paid to the sinuses, and both ears showed no signs of cessation of discharge until the sinus condition was mastered. Note that on the left side this condition distinctly improved, and on the right side the exudate appeared to be wholly cleared from the maxillary, ethmoid, and sphenoid sinuses. Also, the right mastoid cell lumens markedly cleared. The hearing in the right ear is now almost normal. Many similar cases were encountered.

septums appear softened, and the content of lime salts proportionately less. The degree of edema or softening is indicated in the charts by *E, EE, EEE* and *EEEE,* respectively.

Continued edema indicates a low grade process, which may at any time and repeatedly light up into an acute exacerbation of the chronic

state. It was present in 75 per cent of the recurrent and in 80.1 per cent of the chronic cases of suppurative disease of the ear, and frequently varied directly as the deafness.

The technic of examination will not be restated at this time, as the reproductions of the history cards will show sufficiently well its scope and detail.

The following signs are used in all sections of the accompanying history charts. A *V* that points toward the right indicates small, thin or diminished. The degree is indicated by one, two, three or four *V*'s all pointing in the same direction. (Four *V*'s pointing toward the right represent the extreme degree.) A *V* that points toward the left

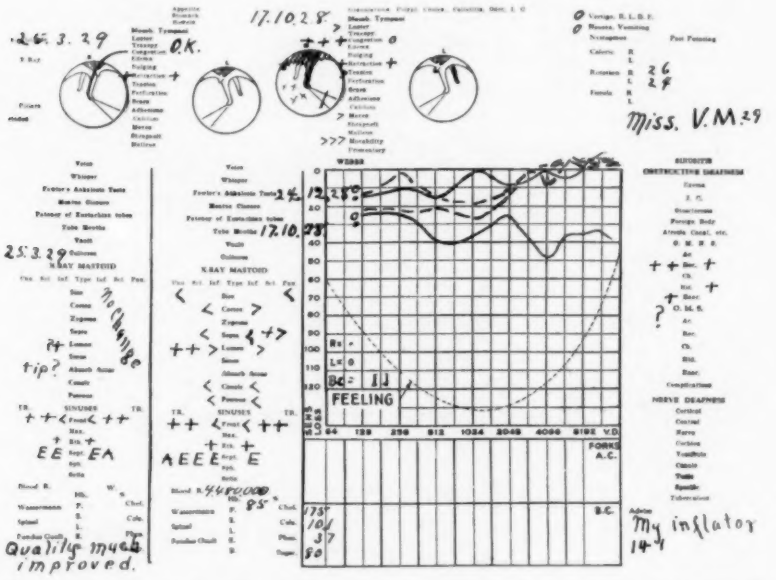

Chart 7 (Viola M.).—This was a case of acute nonsuppurative otitis media in an adult. Notice that the effect of the inflammation was to lower the hearing of the right ear at all frequencies, progressively as the scale ascended. The hearing improved almost to normal coincidently with the improvement in the otoscopic picture and the condition of the nasal sinuses. The septums on the side of the inflammation lost their edema, and the lumen of the mastoid cells markedly cleared. Unless the nasal condition clears up more than depicted, this patient will be apt to have a recurrence on slight provocation. After politzerization on 10/18/28, the patient felt "great relief," though there was really little change.

means large, thick or increased. The degree is indicated by the number of *V*'s. (Four *V*'s pointing toward the left indicate the extreme degree.) A plus indicates that the region marked is positive or involved. A minus indicates that the region marked is negative or not involved. The degree of involvement is indicated by one, two, three or four pluses.

A sufficient number of charts are shown to establish the conviction not only that the deafness and its variations were intimately associated with the coincident variations in sinus disease, but that the aural disease which produced the deafness was primarily caused by the disease in the nasal spaces. (Treatment based on this conviction has added the proof of clinical results.)

As a cause of deafness and of variations in hearing, nasal sinus disease has not received adequate attention. To combat deafness successfully, one must also successfully combat disease in the nose and nasal sinuses.

CONCLUSIONS

1. Stereoscopic roentgenograms, properly taken and interpreted, furnish data for the better diagnosis of and changes in sinus disease.

2. Eighty-six per cent of the diseases of the ear are associated with diseases of the nasal sinuses.

3. The proportion varies greatly in different age and disease groups.

4. Marked variations in the degree of deafness are fundamental signs of a changing pathologic condition of the ear.

5. Changes in the aural disease were regularly accompanied by changes in the nasal disease.

6. The absence of changes in the disease of the nasal sinuses as shown by x-rays does not mean change may not have occurred previously.

7. Unless the roentgenograms and the audiograms are taken on the same day, the variations may be found not to coincide.

8. Coincidental variations occurred so constantly that it is believed that the nasal disease was the fundamental factor in the variations in hearing, and in the etiology of and the changing disease in the ear.

114 East Fifty-Fourth Street.

Clinical Notes

A NEW INSTRUMENT FOR THE CONTROL OF TONSILLAR HEMORRHAGE*

IRWIN I. ALPER, M.D., NEW YORK

This "compressorium" was invented by Dr. Waldapfel of the Hajek Clinic, Vienna. Its aim is to produce adequate, constant pressure over either one or both tonsillar areas in toto, or on any direct bleeding spot in a tonsillar fossa, depending on the conditions present. It has the special attributes of being retained without any discomfort even by a child, and of exerting sufficient styptic pressure over a local bleeding point or the whole tonsillar fossa on both sides at the same time; and yet it is not so rigid as to be uncomfortable when the patient attempts to swallow. It has a joint in it which permits it to move with the act of deglutition without disturbing its position or diminishing its constant pressure

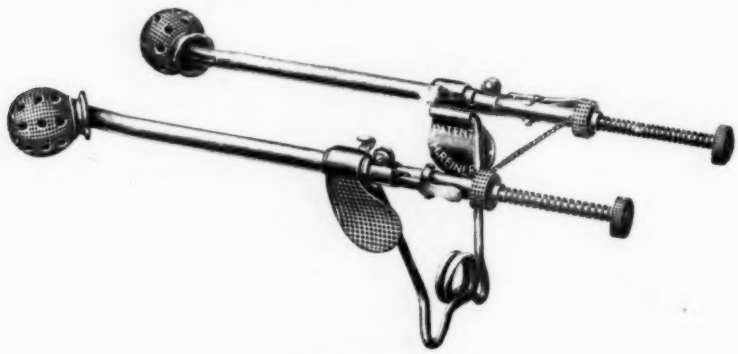

Fig. 1.—Instrument described in text.

in the proper direction. This movement without partial loss of function prevents decubitus, which sometimes occurs with the more rigid types of hemostats.

As the photograph of the instrument shows, it is composed of two round perforated knobs which end at their proximal extremity in a collar-like ridge, which has a rubber ring in it. Gauze tampons can be fitted around the knobs using as many as is necessary, depending on how large a fossa one wishes to compress. The tampons are fixed to the knobs by means of the elastic ring around the groove mentioned. Each knob is attached to a metal tube about 0.5 cm. in diameter and about 10 cm. in length. These tubes end in their proximal extremities in a round metallic disk by means of which one can turn the knobs, even after they are in the tonsillar fossae, in any direction so as to concentrate the pressure at the bleeding points, if desired. By pushing on these plates the knobs are advanced any desired distance. This position is maintained by a notched catch on the metal arms of the instrument. Slight pressure on this catch will release it from its notch, and the arms and knobs will spring back automatically to their original positions.

* Submitted for publication, Sept. 3, 1929.

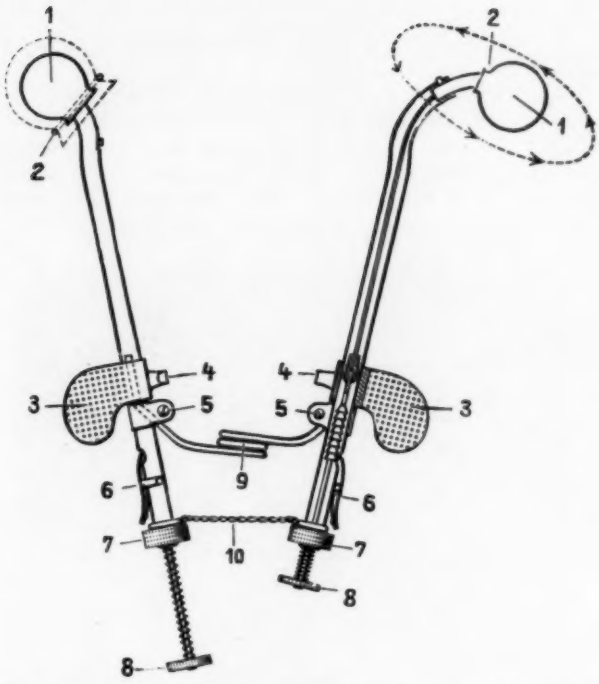

Fig. 2.—Diagram showing various parts of instrument: *1* indicates perforated round terminals; *2*, rubber collars (to maintain gauze in position; *3*, fingerplates to approximate the arms of the instrument; *4*, fingerplate screw; *5*, terminal for spring; *6*, catch to maintain arms at various lengths; *7*, device for rotating arms into desired angle; *8*, pressure knobs to advance the arms of instrument; *9*, spring separating arms, and *10*, chain to prevent labial stretching.

Fig. 3.—Instrument in place.

At the proximal end of each arm is a circular wire spring which exerts its pressure inward. Connecting both arms is a twisted piece of metal in the form of a clasp spring. This tends constantly to separate the arms. Thus the resultant of both forces gives a constant pressure backward (toward the pharyngeal wall) and outward against the tonsillar fossa. This is the most advantageous direction of the pressure to stop bleeding.

Fig. 4.—Hemorrhage on the left side with packing mainly backward and outward. Photograph was taken with barium infiltrated gauze on the left side.

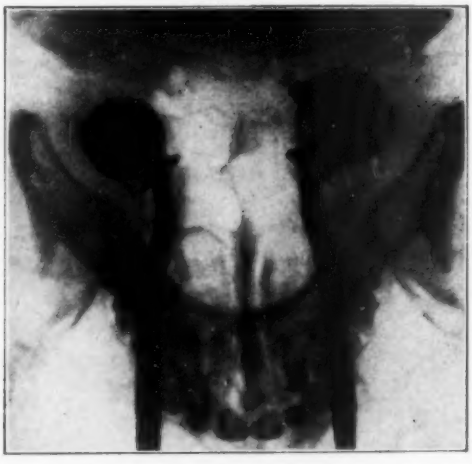

Fig. 5.—Hemorrhage on the left side with packing on all sides.

The utilization of this instrument is simple. First the source of the bleeding is located by sponging. A gauze sponge is then fixed around each knob and is fastened into the groove with the elastic ring. The instrument is grasped between the thumb and the forefinger and is compressed so that the knobs are approximated. It is then inserted into the mouth and released slowly so that a knob rests in each tonsillar fossa. Now the knobs can be turned or the rods can be

lengthened or shortened to fit each individual case and also to concentrate the pressure directly against the bleeding spot. The knob on the nonbleeding side may be turned so as to exert a pressure directly opposite to the knob in the bleeding side, thereby increasing the pressure on the bleeding side.

Fig. 6.—Hemorrhage on the left side with packing mainly backward and outward.

Fig. 7.—Hemorrhage on the left side with packing mainly forward and outward.

In cases with large tonsillar fossae the tonsillar beds are filled with gauze tampons as for ordinary digital compression. The instrument is then inserted as mentioned previously, on top of the gauze tampons. The distribution of the pressure in the packed bed is fairly well equalized, so that it is not necessary to change the direction of the knobs in most cases. If, however, the bleeding is

from an extreme point in the tonsillar bed, the packing is localized over this point, and the knob is applied directly over the tampon.

The instrument can be left in situ until all fear of hemorrhage is gone. Thus, whereas in some favorable cases from one to two hours were sufficient to arrest the bleeding, in other extreme cases the instrument was left in from twelve to eighteen hours without any untoward effects or discomfort and with absolute control of bleeding. I have used this instrument and have seen it used at the Hajek Clinic both as a prophylactic—to prevent bleeding in cases in which the patients were suspected of bleeding, and after postoperative bleeding, with uniform success and without recourse to other more radical methods.

The advantages of this instrument over other methods are:

1. There is a self-retaining elastic system which accommodates itself to the movements of the pharynx, and keeps the bleeding points under constant and equal pressure.

2. The direction of the pressure can be modified as desired to fit the individual case.

3. The knobs remain fixed automatically on each required point.

4. The same instrument can be used on all patients—children or adults—without the addition of extra knobs. It is always ready for use.

5. The instrument can be used prophylactically in cases without bleeding instead of digital pressure.

6. There is a minimum of discomfort to the patient with this instrument. The patient can even take nourishment with this instrument in situ.

7. No extra suturing or traumatizing of tissue is necessary.

8. The instrument combines facility of application with certainty of result.

A NEW APPARATUS FOR ROENTGENOGRAPHY OF THE SINUSES*

HARRY L. BAUM, M.D., DENVER

The apparatus presented herewith has been devised for the purpose of facilitating roentgenography of the sinuses, particularly when the horizontal ray is to be utilized. It is of special advantage to use an apparatus that will permit roentgenograms of the head to be taken with the patient in the sitting position, regardless of whether or not it is thought necessary to use the horizontal ray. This advantage is greatly increased when the latter technic is adhered to. It is my belief that the use of the horizontal ray in roentgenography of the sinuses is at all times desirable, but especially so in those cases in which filling with a contrast medium is employed. Thus, the fluid level is clearly defined, and by changing the position of the head it is possible virtually to reconstruct the cavity to be studied by means of exposures made in the three planes: postero-anterior, lateral and vertical.

This apparatus facilitates the application of these principles and also has an added advantage which I have found of great importance—it enables the operator to center the ray on the film easily and accurately.

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* Submitted for publication, Sept. 26, 1929.

* Read before the meeting of the Midwestern Section of the American Laryngological, Rhinological and Otological Society, Denver, Jan. 12, 1929.

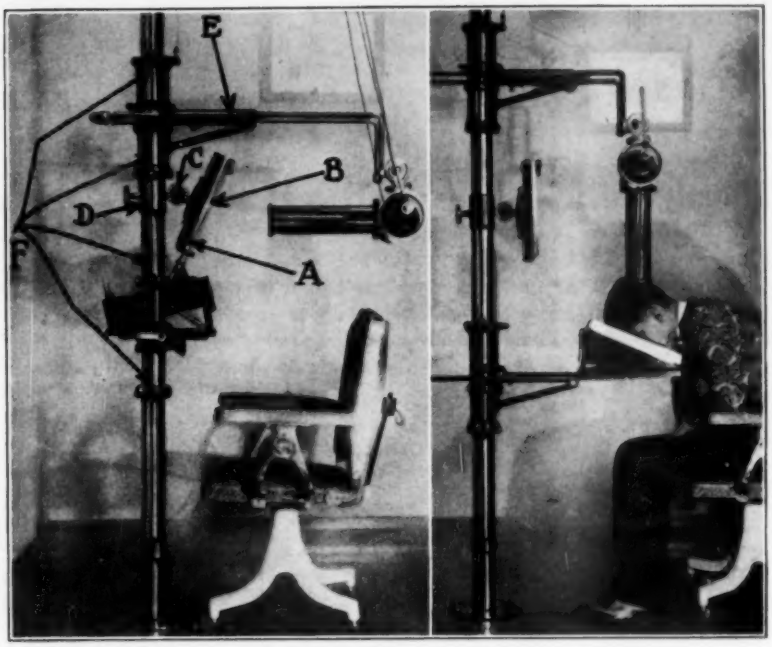


Fig. 1.—In the illustration on the left, *A* indicates the casette holder; *B*, the bakelite panel with nasal aperture; *C*, tilting arrangement (permits adjustment to any desired angle); *D*, sliding collar for raising and lowering casette holder; *E*, tube carrier, and *F*, marking on tube stand, casette holder and tube holder for lining up to center ray on film. The illustration on the right shows the use of the adjustable shelf for making exposure with vertical ray (Granger sinus board).

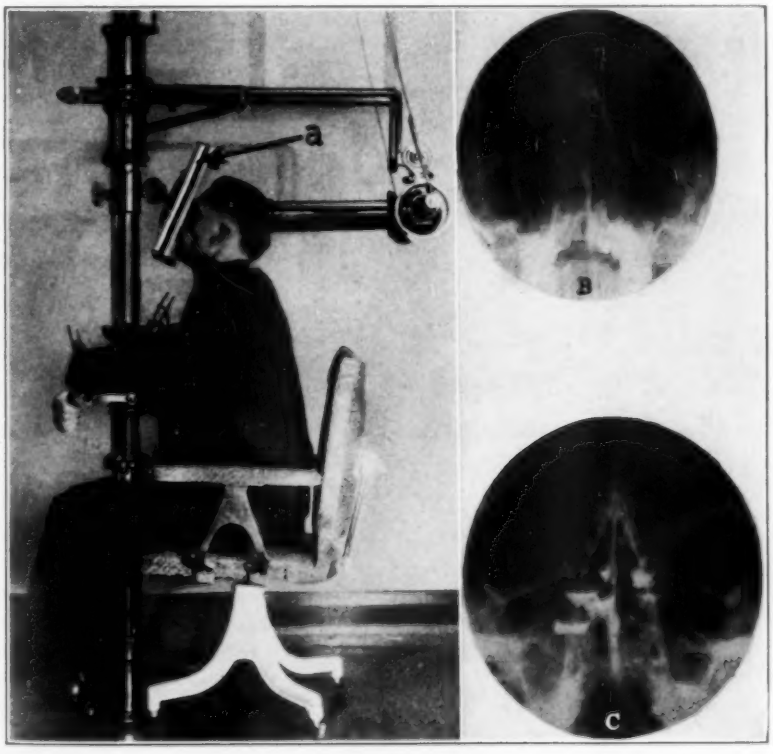


Fig. 2.—*A*, postero-anterior position, 23 degree angle (*a*, casette in position). *B*, postero-anterior film. *C*, postero-anterior film, partial filling. Note fluid level of iodized ail.

It consists (fig. 1) of a tube stand bolted to the floor and supported at the top by attachment to the wall. The casette holder slides freely on the tube stand for quick adjustment to any desired height. It is also adjustable so that it can be tilted to any angle, and is made with a bakelite face or panel in which has been cut an aperture for the nose, in conformity with the principle of the Granger sinus board. The casette slides into the holder or is held against the face of the board (figs. 3 *A* and 4 *A*) for the purpose of making exposures when the Granger position is not used. The tube carrier itself is so mounted and counterbalanced that it can be raised and lowered, or rotated to any angle. In addition the tube

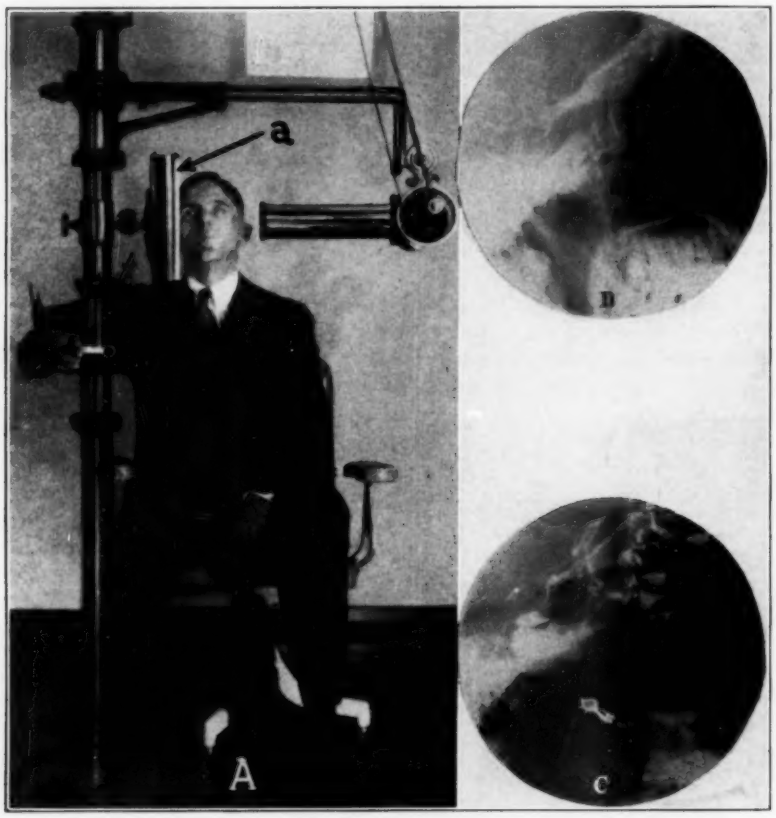


Fig. 3.—*A*, lateral position. Note location of casette on face of sinus board at *a*. *B*, lateral film, without contrast medium. *C*, lateral film with contrast medium.

stand is marked to conform with marks on both the casette holder and tube carrier so that all parts of the apparatus may be lined up at these points by simply setting the markers to coincide. Thus, the ray is centered on the film without necessity for further adjustment and without depending on chance or guesswork for accuracy of centering. The long cone, pressed firmly against the crown, serves admirably for steadying the head, thus eliminating the necessity for more elaborate head holding apparatus. The adjustable shelf can be raised

or lowered as needed and may be used for the conventional positions in sinus or mastoid work, including the making of stereoscopic exposures. It swings out of the way and may be used as an arm rest at other times (fig. 1 *A*).

I wish particularly to call attention to the use of the apparatus for making exposures in what I have termed the chin-vertex position (fig. 4 *A*) which I have been using for some time as the position of choice for delineation of the sphenoid and ethmoid sinuses, particularly when a contrast medium is used. This position is a modification of the one described by Pfahler[1] for roentgenography of the base of the skull and affords a view of the cavities in the vertical plane. I have found the position admirably adapted to this method when modified as shown. *B* and *C* in figure 4 show films made in this position with and without filling.

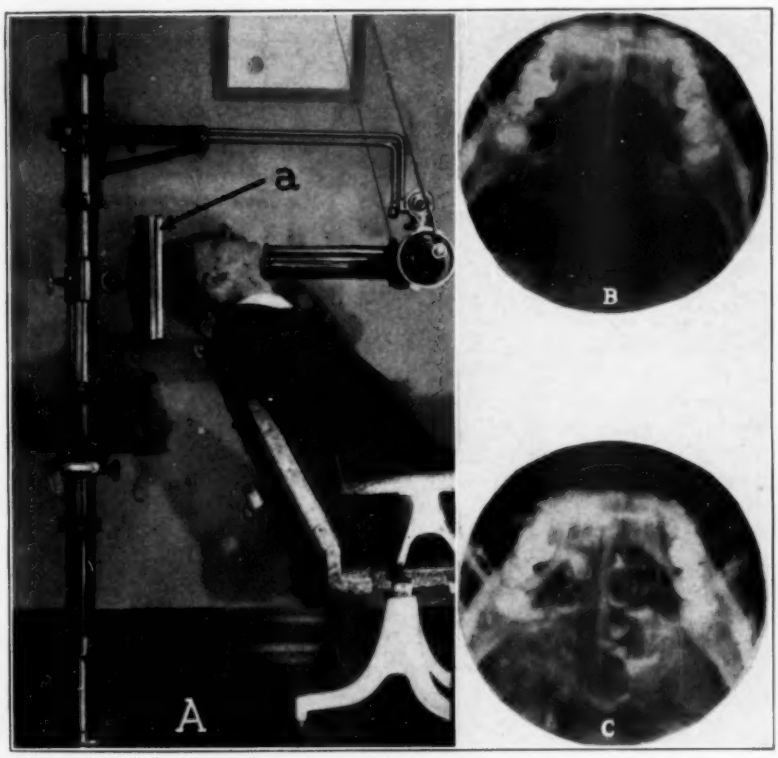


Fig. 4.—*A*, chin-vertex position. Note location of casette on face of sinus board at *a*. *B*, chin-vertex film without contrast medium. *C*, chin-vertex film with contrast medium.

SUMMARY

This apparatus incorporates the following advantages:

1. It permits the making of roentgenograms of the head while the patient is sitting.

1. Pfahler, G. E.: Roentgenologic Signs Which Indicate Extension of Infection from the Ethmoid and Sphenoid Sinuses to the Base of the Skull. Tr. Sec. Laryngol., Otol. & Rhin., A. M. A., 1928.

2. It applies the principle of the horizontal ray in a convenient manner.

3. It provides a quick and simple means of centering the ray on the film, thus permitting the use of a small cone with unfailing accuracy.

4. It is also adapted to the positions in common use at the present time.

510 Republic Building.

A NEW OPERATIVE TREATMENT FOR ATROPHIC RHINITIS WITH OZENA

Preliminary Report *

IRVING I. MUSKAT, M.D., CHICAGO
Associate Surgeon, Illinois Eye and Ear Infirmary

Up to this time there have been many methods of approach for the cure and relief of patients with atrophic rhinitis with ozena, based on the various clinical and pathologic interpretations of this malady by different investigators. From a survey of such work one comes to the conclusion that notwithstanding the fact that the etiology of this disease is still shrouded in mystery, the better results in its treatment have been obtained from operative procedures which have had as their object the reduction of space of the nasal chambers. This has been accomplished to some extent by the methods of Lautenschlager and Halle, whereby the nasal chambers are reduced in size by bringing in the lateral nasal walls.

As these operations were formidable and are now seldom used, there have evolved the operations of implants and transplants consisting of bone, rib, cartilage, fat and ivory, which are placed under the mucous membrane of the septum. The reduction in space of the nasal chambers has also been accomplished by the injection of paraffin or blood under the mucous membrane as well as the placing of sterile petrolatum under the mucous membrane of the floor of the nose by a pocket made through the under surface of the upper lip.

The procedure of these injections and transplants proved to be simpler than the cumbersome and difficult operations of Lautenschlager and Halle and their modifications, but the results were not better. The failure to relieve the atrophy of the mucous membrane and crusting with its fetor is no doubt therefore due to some extent to the nature of the grafts and implants thus far used.

The objections to these implants are that they either are foreign bodies or become absorbed. Autogenous grafts such as bone, rib or cartilage entail the removal of vital parts from another place in the body. To overcome these objections I have chosen the transplantation of fascia lata from the thigh as the ideal method. The transplantation of fascia lata becomes the ideal material and method when its many advantages and virtues are considered. Fascia lata is readily accessible and can be obtained in almost unlimited quantity. Its removal from the thigh does not disturb the function of the limb in any way. Its texture lends itself to any manner of accommodation as a graft. It is an autogenous substance and requires a minimum of nourishment to retain its viability. It is a sturdy, strong tissue and is not easily infected. Furthermore, because of its histologic nature its physiologic function as a graft gives it added clinical value. Thus as a transplant

* Submitted for publication, Sept. 27, 1929.

fascia lata is so thin that it is easily permeated by serum. It shows little or no degenerative changes after direct transplantation and does not become encapsulated.

These virtues have been proved in the use of fascia lata grafts in many other phases of plastic surgery, and its value as a graft now becomes paramount in the treatment for ozena. Its use here gives support and nourishment to the atrophic mucous membrane and reduces the size of the nasal chambers.

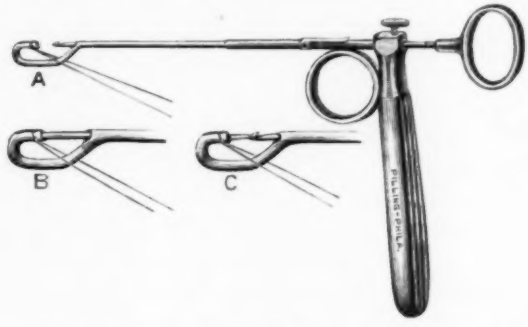
I have operated on one patient with marked atrophic rhinitis with ozena by the transplantation of fascia lata under the perichondrium of the septum and periosteum of the base of the nose, and I am reporting its use for the first time in this condition. The technic and results of this operation will appear in a later communication.

30 North Michigan Boulevard.

NASAL SUTURING INSTRUMENT *

C. Arbuthnot Campbell, M.D., Steubenville, Ohio

To shorten the duration of an operation and simultaneously to smooth the technic are my endeavors. Both rhinologist and patient complain of the suturing in a submucous operation (mucous membrane of a submucous resection of the septum). Many physicians have ceased to use sutures. The instrument here



Instrument used for nasal suturing. *A* shows the instrument threaded for use. *B* shows the needle pushed forward and engaged in the open end of the tubular portion. *C* shows the needle drawn, bringing the suture with it.

presented is an attempt to aid from several points of view, and makes it possible to suture to a depth of several inches in the nose.

The instrument consists essentially of two parts: A tubular section with a handle attached and a barbed needle which slides back and forth in the tubular part. The tubular part is bent, as shown in the illustration, to receive the needle when it is propelled forward, and is slotted crosswise about one sixteenth of an inch (0.15 cm.) from the end to receive suture material.

In the picture, the sectional cut *A* shows the instrument threaded for use. *B* shows the needle pushed forward and engaged in the open end of the tubular portion. *C* shows the needle drawn, bringing the suture with it.

* Submitted for publication, Oct. 24, 1929.

After the needle is threaded, two flaps are approximated by forceps, and with one movement the needle is passed through both flaps. This is quickly and easily done. The suture is readily tied. In cases in which it is inconvenient or impossible to follow the technic given, the threaded needle may be passed through one flap, rethreaded and then passed through the second flap; the silk is then tied. The deeper the suture is to be placed in the nose, the greater the dexterity that is required. It can be readily seen that the advantages of this technic are: (1) simplicity, (2) accuracy, (3) speed and (4) ability to suture to a depth of several inches in the nose.

Progress in Otolaryngology

A Summary of the Bibliographic Material Available in the Field of Otolaryngology

FUNCTIONAL EXAMINATION OF HEARING; DEAF-MUTISM AND EDUCATION OF THE DEAF*

ROBERT SONNENSCHEIN, M.D.
CHICAGO

One of the most striking facts that I have noted in looking over the literature from Oct. 1, 1928, to September, 1929, is that so few articles on functional testing of hearing have appeared in the European journals. It has been my usual experience to find that most papers relating to this subject have for a good many years appeared especially in the German journals. This last year they have been absent so far as I have been able to determine. I have found one article in French dealing with the audiometer of the type most used in America, and all the other papers were those which appeared in England and in this country, particularly the latter. This is a decided reversal of form from that which was observed in previous years when American or English writers seemed to deal with this subject only on rare occasions. It can be accounted for only on the assumption that in Central Europe attention has lately been directed more to operative procedures, pathology, etc., and much less toward devising new tests for hearing or modification of the older tests. On the other hand, it is encouraging to note the increasing interest English speaking writers are evincing in the careful functional testing of hearing. Altogether the articles that have appeared throughout the literature are much less numerous than usual, and this makes the review much shorter than it has been during the past few years.

It is a curious thing that some years more attention is paid to certain items than in other years. About two years ago, the interest in audiometers was intense, and many articles were written regarding them. During the past year, the question of malingering, especially of simulated total unilateral deafness, has brought forth a number of papers. Practically all of the articles rest on the principle that when the ear which is supposed to be deaf is masked, the subject cannot tell whether he hears the sound in the opposite or admittedly better ear. Various types of apparatus have been employed, but I am still of the opinion that the simple Stenger test answers all requirements. In England a number of men have endeavored to establish a method for obtaining definite units as applied to defects in hearing. Their mathe-

* Submitted for publication, Nov. 28, 1929.

matical formulas, however, in the opinion of some physicists, do not fulfil the requirements of designating exact units.

After this review had already been prepared, there appeared in a supplement to the *Acta oto-laryngologica,* an article by Dida Dederding, entitled, "Clinical and Experimental Examination in Patients Suffering from Morbus Meniere, Including a Study of the Problem of Bone Conduction." This is a detailed account of the examination of 135 patients and takes into consideration every standpoint of diet, physical condition, etc. The main thesis is that of Meniere's disease, but considerable attention is also paid to bone conduction. This article will be read and a review submitted next year.

T. A. Clarke [1] reviewed the functional tests thoroughly, emphasizing their shortcomings and in addition described means of placing auditory tests on a rational, accurate and convenient basis. In testing tonal range limits he said that the audiometers are not of great value. He stated the belief that the monochord is a convenient and accurate agent for testing the upper limit of hearing. The monochord has the advantage that its sounds may be transmitted by bone conduction. In every case of deafness, conductive or perceptive, the upper limit is lower by air than by bone conduction, and often to a marked degree. I also found it to be so in normal persons; I quoted Kalahne for an explanation.

The Schwabach, Weber, Rinne and Bing tests fail to justify their prominent place in the routine testing of patients because they give incomplete and often misleading information. In referring to Gellé's test, Clarke presented results obtained in eighty cases. His results show that first, otosclerosis has little or no influence on the result; second, that the test is unsound in theory, for it is as frequently positive when the drum is perforated as when the drum is intact; and third, he suggests that the significance of the Gellé phenomenon is still unknown.

Under the suggested improvements in qualitative testing, he advised the use of the absolute bone conduction test to determine readily and accurately the perceptive component. Certain elementary points require attention in carrying out the test. The meatus should be occluded without an increase in pressure which can be accomplished either by pressure on the tragus or by inserting the moistened finger into the meatus. Any fork between 128 and 1,024 double vibrations per second may be used, preferably the 256, 512 and 1,024 forks. In normal cases perception by absolute bone conduction is slightly less than by air conduction. Conductive disease results in loss of hearing power by air conduction with normal perception by absolute bone conduction. Perceptive deafness involves diminished hearing by both air conduction and absolute bone conduction with the excess of air conduction being if anything increased over the absolute bone conduction. The absolute

1. Clarke, T. A.: Hearing Tests, J. Laryng. & Otol. **44**:83 (Feb.) 1929.

bone conduction test affords an absolute index of the perceptive function, whereas the Schwabach test is influenced perhaps simultaneously by changes in both perception and conductive functions and is, therefore, indicative of neither. Bone conduction as such does not exist, but it is really conduction by resonance. The sound vibrations produced when a tuning fork is placed on the skull are conveyed to the cochlea not by conduction as such but by sympathetic resonance of the cranial structure. Under such conditions, one would expect that the effective stimulus would be no greater in the region of application of the fork than at a distance. The existence of this condition by resonance conveys important implications affecting the performance of and deduction from the tests. In view of this resonance conduction, the use of the Bárány noise machine in the ear opposite to the one to be tested is required less frequently in the absolute bone conduction test than in the relative bone conduction test. This is explained by the presence of cross-stimulation which is dependent on bone conduction by resonance. With this present, it is impossible without special precaution to demonstrate any loss of sensitivity greater than that which requires a stimulus so loud as to effect the ear opposite that tested. When this cross-sensation is anticipated, the Bárány noise machine must be used to exclude the opposite ear. In the Schwabach test the normal sensitivity of the two ears is equal, and to demonstrate any degree of reduced sensitivity a Bárány box is essential. However, in the absolute bone conduction test the normal sensitivity of the ear tested is raised considerably above that of the opposite ear in which the meatus is not being occluded, enabling one to demonstrate a considerable degree of nerve deafness before a Bárány box becomes necessary.

Quantitative testing is even less satisfactory than the qualitative. There is a great need for a method of quantitative testing which will yield accurate results and be comparable whenever obtained. Of the various expressions for hearing defect that of the normal hearing distance is the most valuable, rendering results which are intelligible even to the untrained mind. If one has a 10 per cent normal hearing distance, it is readily understood that he is able to hear a sound only one-tenth the distance that it is heard by a person with normal hearing. It is also a natural instinct to speak of deafness, the loudness of sounds, and hearing in general in terms of distance. For this reason the tests which are on a distance basis as the voice, watch or acoumeter have been most used. These tests have more disadvantages than advantages for quantitative testing. The audiometer which is a great advance will probably never come into routine use because of its complications, lack of portability and cost.

The tuning forks which are essential for qualitative testing deserve considerable attention in the consideration of quantitative determinations, since their results can be expressed in terms that are both convenient

and universally applicable. The two methods which have been used, the fractional, and the expression of hearing defect as the number of seconds deficiency for a fork, are not accurate. The expression of hearing power merely as seconds deficiency for a fork ignores the wide differences in the rate of decrement of forks, and the fractional method does not consider the initial amplitude of vibration of the fork, which varies widely not only in different forks but also in the same fork. Attempts to overcome these defects by producing forks of universal and constant initial intensity as well as universal similar decrement have met with little success, and it is doubtful whether future attempts will meet with greater success.

Clarke suggested a method whereby both the expression of hearing power in terms of percentage retention of normal hearing distance, and the tuning forks are utilized. The hearing is tested in the usual way, and the duration of after-perception of a tuning fork noted by the normal ear after the patient has ceased hearing it is noted in seconds, seconds of deficiency. The figure is then translated into percentage of retention of normal hearing distance by reference to a table. Such a figure is open to comparison and will be identical with the results for the patient examined with other forks or instruments of the same pitch. This table could be supplied by the makers of the forks at the time of purchase or can be either drawn up at the expense of little time with the aid of a few experiments and a little practice in mathematics or standardized by a central institute. If quantitative estimation for only a single pitch is wanted, reference to a small printed table will be convenient; if complete testing for a range of forks is wanted, a graph recorder as suggested by Lowndes Yates could be used. The objection to the test is that a second personal factor is introduced. However, with only a little practice one is able to say with confidence when the end point of perception of the fork is reached. Normal hearing for the examiner is essential. No special tuning forks are needed for the test. The low forks, however, should be as free from overtones as possible with a fairly rapid rate of decrement so as not to make the test too tedious. The higher forks should be of good quality with as slow a decrement as possible. The translation of results from seconds deficiency for any fork to percentage normal hearing distance is merely a matter of referring to the table. The mathematical and physical basis underlying the test and for obtaining the figures on the table is presented in detail.

For quantitative estimation of perceptive function the absolute bone conduction test can give valuable information. The end point of perception in testing absolute bone conduction cannot be obtained with the same accuracy as in testing air conduction. The value of the test is also confined to pitches between 728 and 1,024 double vibrations per second. The factor of auditory fatigue which can be greatly overcome by lifting

and replacing the tuning fork is also recommended. The efficiency of contact between the base of the tuning fork and the skull plays a large part in determining the amount of perception in this test. With a little practice, one can learn to use a fairly constant degree of pressure, thus reducing this error to negligible proportions. The quantitative estimation depends on the expression of "absolute bone conduction" in the terms of air conduction. In testing a patient, one determines the end-point of his perception by absolute bone conduction and then determines how much longer the sound is heard by the normal subject. This seconds deficiency of absolute bone conduction cannot be compared to seconds deficiency of air conduction because of the more rapid decrement of the fork's vibration when applied to the mastoid entailing resonance of the cranial structures. The increase in decrement is determined for each fork with sufficient accuracy for all ordinary purposes and is explained by Clarke with an example. The patient's absolute bone conduction need not be compared with the normal absolute bone condition. This seconds deficiency as compared with the normal perception by air conduction may be determined when the interval between the normal air conduction and the normal bone conduction is known. The results so obtained for absolute bone conduction can be directly compared with those obtained from the tests of air conduction, and then translated into percentages of normal hearing distance by referring to the same table previously mentioned. This is readily graphed or expressed in a fraction when the patient's absolute bone conduction expressed as percentage normal hearing distance is placed over the normal percentage absolute bone conduction for normal hearing distance. Clarke then gave his complete personal procedure of examinations, which he stated occupies only twenty minutes, including the production of graphic records. First he tests with the watch or the acoumeter if the distance is small. Then the patient occludes both meatuses, and a vibrating tuning fork is placed on the glabella. If there is any lateralization of perception, he knows there is a unilateral or unequal bilateral perceptive deafness. A fork preferably *c-1,* 256 double vibrations, is held close to the tragus, and when perception ceases, it is transferred to the base of the mastoid occluding the meatus by pressure on the tragus with a finger of the other hand. When perception ceases, the fork is transferred to the experimenter's mastoid to determine whether there is any further perception by absolute bone conduction. If there is, then the patient has some additional perceptive deafness. Quantitative estimations for the two ears may be performed at the same test, but air conduction and absolute bone conduction are best tested separately. All the necessary particulars are in the decrement table. Then he tests with the *C-5* fork and usually tests the upper limit (Monochord, air conduction and bone conduction) and the lower limit. If complete investigation is required,

he then proceeds to do quantitative tests for all the forks, *C-1* to *C-5* by air conduction, *C-1* to *C-3* for absolute bone conduction.

In conclusion, he stated that he had outlined methods for accurately determining the total hearing power (air conduction) and the perceptive function (absolute bone conduction), from which data the condition of the conduction apparatus can at once be deduced. The results are expressed intelligently and are comparable whenever and by whomever they may be obtained. If necessary, they can be expressed in graphic form. Such full testing carried out as a routine would result in some reorganization of ideas and the general improvement of otology.

F. W. Kranz stated the belief that the older tests are not sufficient. Considering "total hearing ability," "conductive ability," and "perceptive ability," the first is the sum of the other two, and if two can be measured, all will be known. Test of absolute bone conduction will give perceptive component. That this is a true index of purely perceptive function is shown by the fact that almost anything can happen in the midle ear or to the tympanum and cause no appreciable difference in results of this test.

Normally absolute bone conduction is slightlv less than air conduction. Tests of total hearing can be made and defects can be expressed in several ways, e. g., arbitrary units, sensation units, etc., or on a hearing distance basis. The author chooses the last method. He adopts a scale which is really a purely arbitrary one, on the assumption that hearing power is directly proportional to the distance at which a given sound can be heard. Thus by comparisons of deaf persons and persons with normal hearing, he arrives at a percentage of normal hearing distance to express the patient's hearing power. If forks are used for testing, the time difference can be translated into a distance ratio by means of a table prepared by preliminary experimentation with the fork.

It seems that his "quantitative" scales for measuring bone conduction and also total hearing are both arbitrary inventions, and subject to change with change of fork, etc. Certainly the results are not in such units as allow a conclusion that the difference in the numerical results of the two tests represents the air conduction in any rational or universal units.

The author's statement regarding "10 per cent normal hearing distance" as representing one-tenth normal distance heard is misleading, as most persons then believe that means one-tenth hearing ability, whereas it probably means one-hundredth or less according to the inverse square law.

I believe the author is somewhat mistaken regarding the initial amplitude of forks. Unless the same fork is struck with markedly different force, its initial amplitude is practically the same each time. If a pendulum blow or impact with a pleximeter is used, employing the

same arc of fall in striking the prong at the "percussion point," sufficiently uniform excitation is obtained for all practical purposes.

In this rather detailed article, Devaux [2] described the audiometers and the methods of their use. He based his work on that done by Americans, especially the men connected with the Western Electric Company and the Bell Telephone Laboratory. The bibliography is complete, and all of his references are to articles by English and especially American investigators, with the exception of those of two Frenchmen. Fletcher and Wegel are especially quoted, but the work of Fowler in this country and that of Dan Mackenzie in England are mentioned. It is refreshing to read a foreign article which shows the intimate knowledge and the acquaintance with the various steps of the excellent research work done especially in this country in the way of the development of the audiometer, etc. In his conclusions the author stated that the new method of testing hearing has furnished something new and important, namely, the sensation unit. The audiometer is simple in its manipulation, and gives a graph or curve which is a record of great precision. In order to supplant testing with the whispered and conversation voice, Devaux also mentioned the fact that the phonograph audiometer may be used. By means of an instrumental examination, he believed that one will be able, by this method of precision, to supplant and do away with the personal observation of the examiner. He further stated the belief that the use of this instrument will result in the acquisition of much knowledge regarding the physiology of hearing.

I wish to say that Shambaugh has repeatedly stated that the audiometer, especially the *A-1* type, is of greater value in research of otologic problems than it is as an instrument for practical results in the functional testing of hearing as compared with tuning forks. Devaux believed not only that the audiometer is of use in the clinic, but that it is valuable for testing the employees in various kinds of work such as railroad, and last but not least, it is of great aid, especially when the phonograph audiometer is used in testing children.

This excellent article will prove a mine of information for French readers, but because of the fact that the development of audiometers in Europe has been rather recent, it will not be easily assimilated at once because foreigners have not been educated in this regard to the extent that obtains in the United States. In fact, it was pointed out in the review of last year that only comparatively recently did the German investigators start developing audiometers to any considerable degree, and the models that they previously produced have been much simpler than those developed by the Western Electric Company.

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2. Devaux, H. C.: Un procede nouveau d'accoumetrie, Ann. d. mal. de l'oreille du larynx, **48**:27 (Jan.) 1929.

Hastings [3] stated the belief that the comparative ignorance concerning both the pathology and the treatment in so many cases of deafness of both the middle and the internal ear types is due in part to the methods of examination which have been used in the past. He expressed the feeling that for a scientific study of deafness arbitrary units of hearing must be given up and an attempt made to discover what percentage of the normal power of conduction and the normal power of perception is present for pure sounds of the principal wave lengths. The ordinary method of estimating bone conduction by means of a vibrating tuning fork placed on the mastoid is open to a thousand fallacies, since the more complete the interference with conduction through changes in the middle ear, the longer will the sound of the tuning fork be heard. One of the tests recommended by a certain committee in 1917 was the "absolute bone conduction" test. This test is carried out by having both examiner and patient block his external auditory meatus with his finger, and placing a vibrating tuning fork alternately on the mastoid of the examiner and the patient until it is no longer heard. Thus the bone conduction of the two persons is compared. Hastings stated that as long as he has used this test he has never found any case in which the absolute bone conduction is increased beyond the normal. The statement that bone conduction is increased in otosclerosis is erroneous when applied to absolute bone conduction. Obstructing the meatus increases the perception for bone conduction considerably. Therefore if the degree of bone conduction in the two ears is approximately equal, the test will not be vitiated by a conductive deafness in the untested ear regardless of how great the impairment may be. Difficulties will arise only when there is a marked perceptive deafness on the side being tested, with good cochlear hearing and considerable conductive deafness on the other side. In such a case the patient will immediately say that he hears the tuning fork in the opposite ear, and then the ear not being tested can be excluded with a noise machine or by rapid movement of the finger in the meatus. With the "absolute bone conduction" test it is possible to estimate the percentage of normal perceptive hearing retained by a patient by noting the difference in time between the bone conduction of the patient and the examiner and then translating it into percentage by means of a table given for this purpose. The total hearing power and percentage can be figured according to the methods of Lowndes Yates, Clarke, and others by noting the differences in time that a fork held at similar distances from both the patient's and the examiner's ear is heard and then converting them into percentages by means of a table or graph. With both the percentage

3. Hastings, S.: Estimation of Hearing Capacity, J. Laryng. & Otol. **44**:73 (Feb.) 1929.

for total hearing and the percentage of perceptive hearing known, it is easy to determine to what extent the deafness, if any, is due to changes in the conduction apparatus. Although these methods are laborious and crude, there is no other at present that will tell the examiner what he wants to know. This author stated the belief that "our investigations regarding otosclerosis or other researches will not prosper until we have standardized methods for testing ears and estimating hearing capacity."

It is well known (Bing's test) that occlusion of the external auditory meatus will increase bone conduction in the normal subject or even in one with some involvement of the inner ear, but when bone conduction is already lengthened in a case of impairment in the conduction apparatus, it will not increase bone conduction.

The author repeated the old fallacy of misapplication of the law that intensity of sound varies inversely as the square of the distance. It should be understood that this law applies only to a point source of sound and to conditions of no reflection of sound. A tuning fork is far from a point source, and usual rooms have considerable reflection; so calculations on the basis of this law are valueless.

For total hearing power of the patient the author takes the time the patient hears the fork and the time a normal person hears it at the same distance. From a table he converts time deficiency into space deficiency, and the square root gives the power ratio. According to Kranz, it does not do so. Extension of this to bone conduction takes the time deficiency of the patient's bone conduction as compared with the air conduction of the normal and translates this into space deficiency according to this table. He does the same for normal bone conduction and air conduction and then compares the patient's bone conduction deficiency with normal bone conduction deficiency. "This is highly artificial as normal air conduction is not more of a standard than normal bone conduction, and space deficiency is no more of a standard than time deficiency. Far better use standardized or calibrated forks and deal only with observations of time. The measurements are not made any more absolute by the author's procedure (Kranz)."

Keen [4] found in the course of applying the hearing test to pensioners that the hearing distance for both ears together often exceeded that for the better ear when the hearing distance was determined in a forward direction; i. e., by facing the patient and taking special precautions to exclude lip reading. Some evidence is produced to show that this addition actually occurs in mathematical proportions. The physical considerations are based on the well known law in acoustics which states that the intensity of a sound wave spreading out from a point varies inversely as the square of the distance from this point. The difference

4. Keen, J. A.: Intensity Perception in Monaural and Binaural Hearing, J. Laryng. & Otol. **44**:315 (May) 1929.

in the hearing distance when both ears are tested together is not always obvious. In measuring the hearing power of the ears in terms of distance the difference between the two sides may be expressed as the square of these distances. The combined distance X would be given by the formula $X = \sqrt{D^2 + d^2}$ where D and d are the hearing distances of the better and worse ear, respectively. The argument and formula are worked out in detail. Examples of hearing tests are given to show this relationship. Many persons however, do not conform to this principle, which is probably due to the approximate nature of all voice tests for hearing. In testing with the observer facing the ear, there is an advantage in that the sound waves coming from the side are more easily collected and directed into the meatus than are those coming from a front position. Furthermore in sideways testing there is the additional advantage of eliminating lip reading without any special precautions. The various difficulties found in hearing tests, such as control of voice, fatigue phenomenon on the part of the patient, size and shape of the room, etc., could easily produce the differences found in some of the cases. In addition it may be found that the increased hearing power of both ears is present only when the source of sound is placed in the medial plane of the head resulting in sound vibrations reaching both ears in exactly the same manner. The wireless ear phones and the stethoscope provide an illustration of this greater power for intensity perception of both ears together as compared with that of each ear separately. The audiometer type of apparatus may possibly supply the actual proof of this phenomenon.

The various theories of intensity perception are discussed as applied to the group of hearing tests discussed. In the examples shown the threshold value is lowered when both ears are receiving the sound impressions as compared to the minimal intensity required when only one ear is listening. This is easily explained on Boring's hypothesis which states that the louder the note the larger is the number of cochlear nerve fibers stimulated. The law of Adrian postulates that the louder the note the greater is the frequency of the rhythmic impulses travelling along the identical number of cochlear nerve fibers. According to this law, a source of sound must be sufficiently strong to stimulate a certain number of nerve endings on the basilar membrane before an impression of sound is received. If both basilar membranes are being stimulated, the source of sound could be less intense and still might produce an auditory impression.

Lemere [5] has worked out a chart whereby the readings of the audiometer can be recorded at once in percentage, as quickly and as easily as

5. Lemere, H. B.: A Percentage Chart for *2-A* Audiometer, Arch. Otolaryng. **9**:442 (April) 1929.

they are now recorded in sensation units. Two charts are presented, one with directions for its use, and the other an illustration of an audiogram in a case of progressive deafness. The advantage of this chart of percentage loss is that it gives a clearer idea of the proportionate loss of hearing for each note as related to the whole range of hearing, and it involves less labor and less likelihood of error than the conversion method now relied on.

For those who use the audiometer as a routine in practice or in the clinic, such a percentage chart may prove of considerable value.

Three hundred and fifty-three patients in the medical and surgical departments of the Johns Hopkins Hospital who had no subjective indication of deafness were tested with the Western Electric 1-*A* audiometer tones, from 32 to 16,384 double vibrations being used as stimuli. The records were grouped according to the ages of the patients, and the threshold readings were tabulated in the form of "scattergrams." The mean variations for the threshold readings were calculated. The mean for all groups differ very little for tones under 512 double vibrations. Observers over 60 years of age have an average threshold which is lower than the other groups for 512 double vibrations. Those in the fourth decade hear 2,048 double vibrations as well as those in the third, but each successively older group shows increasing loss for this tone. For tones of higher pitch, each successive age group shows a decrease in sensitivity, few in the older groups being able to hear the high pitched tones produced by the audiometer at its maximum intensity (Bunch[6]).

It has been long held that the hearing for high tones diminishes considerably with increase in age after middle life, and this excellent article offers much evidence to confirm this view.

It is an important matter to recognize gross variation in the sense of hearing and to determine the seat of the disease and the cause, if possible. This is of value in the military service,[7] especially when the degree of remaining hearing can be stated in concrete terms so as to enable one to determine the trend of the disease, the proper treatment and environment and to establish a more accurate prognosis. If this can be determined by a procedure which can be performed in a standard manner by different competent observers at various times, it becomes particularly valuable and can be placed on a similar accurate basis as eye, blood pressure, etc.

The audiometer presents the easiest means for determining accurately air conduction auditory acuity but is inferior in the estimation of bone conduction and for the necessary comparison of bone conduction and air conduction. In addition, the audiometer is expensive. Both air and

6. Bunch, C. C.: Age Variations in Auditory Acuity, Arch. Otolaryng. **9**:625 (June) 1929.

7. Sonnenschein, R., and Reasoner, M. A.: The Use of Standardized Tuning Forks and Hearing Tests in the Military Service, Mil. Surgeon **64**:169 (Feb.) 1929.

bone conduction auditory acuity can be determined with a set of properly calibrated tuning forks. They are not expensive, are easily transported and are essential in other tests of the auditory apparatus. As a matter of simplification and standardization the routine yearly physical examination might be accomplished with the set of tuning forks. It is true that with a limited number of forks determinations cannot be made at eight different pitches as with the *2-A* audiometer, but a sufficient number can be made to cover all necessary purposes. With the assistance of Drs. Mackenzie, Hetrich, Parker and members of the Committee on Standardization of Tuning Forks and Hearing Tests of the American Academy of Ophthalmology and Otolaryngology, a selection of forks was made and a complete detailed list of specifications drawn up. These are represented in this paper.

A substitute for the steel fork is the new magnesium alloy fork, which was developed at the Riverbank Laboratory and presented and first described by Sonnenschein in the annual report of the committee on standardization of tuning forks and tests of hearing in 1927. The two great advantages of the magnesium alloy forks are that they are rust proof and extremely light. The overtones of the lowest pitched forks are no greater than those of some of the steel forks. The duration by air conduction is as good as that of the steel forks with the exception of the *c-4* and *c-5* forks. These are much shorter than the steel forks, whereas the remainder of the forks vibrate as long and some even longer than the steel forks of the same pitch. For bone conduction the magnesium forks do as well as the steel ones. A series of these forks from 16 to 4,096 double vibrations has been perfected which will in all probability cost less than the first class steel forks. The damping constant for these forks can be determined at a cost of about a dollar and a half, which is somewhat lower than the charge made by the Bureau of Standards for steel forks. Whether these forks will eventually replace steel forks one cannot state definitely at the present time, but it is believed that this type of fork should be more extensively studied so that some definite conclusion can be made regarding it.

A list of the requisites which good forks should have as well as the method of excitation, the application to the patient, the determination of loss of hearing in sensation units by means of the known damping constant and the overcoming of overtones is presented.

The routine method of testing the hearing consists of general inspection, the preliminary tests of hearing, using the whispered voice or the watch and Politzer acoumeter which are not so satisfactory and practical, and the determination of the upper tone limit, using the Edelman-Galton whistle or preferably the monochord and the tuning fork tests. The most important tuning fork tests are the Weber, Schwabach, Rinne and the Stenger. These are all discussed thoroughly.

It is a general rule that the middle ear should be inflated after the tuning fork and voice tests. If improvement is then manifested, the prognosis is good; if there is no improvement, the prognosis is generally unfavorable. In conclusion, a complete recapitulation of the principal hearing tests is presented.

Mackenzie [8] described briefly those methods for detecting simulated unilateral deafness which have proved most reliable to him in an experience covering the study of a fairly large number of cases. A careful history is important, and occasional remarks as of neglect following a slight injury may lead one to suspect a possible case of malingering. A malingerer usually presents an exaggerated effort to hear as compared with a person who has true deafness. There is a lack of cooperation on the part of the malingerer, usually manifesting itself in the functional tests of hearing, in which variability of results are generally present. There is usually a hesitancy or delay in the patient's replies showing itself most typically while tests with the conversational voice are being made. The patient usually asks to have the word repeated several times before suddenly answering as though the word had just become apparent to him. In repeating, he will repeat incorrectly words or numbers having no resemblance to those asked. Tinnitus and vertigo are usually absent in cases of malingering. The absence of bone conduction over the mastoid of the deaf ear is a characteristic observation in unilateral simulated deafness. There is also an absence of hearing with the Weber test when the meatus of the good ear is closed with the finger. This should ordinarily increase the sound in the ear, but the one feigning deafness will claim that he ceases to hear the fork altogether even though he may state he heard it before placing the finger in the canal of the ear. He will also fail to speak in a louder tone when a noise apparatus is placed in his good ear, because he is still able to hear with the supposedly deaf ear. The Stenger test which is by far the best single test in these cases is positive for malingering. The Western Electric Company has now devised an apparatus known as the *42-A* Test Set which is recommended for use in the detection of malingering. Mackenzie stated the belief that this is a good substitute for the pair of *a-1* forks of Bezold and has two advantages: first, a constant stimulation which is not possible with the forks, and second, a stimulation of equal intensity on the two sides which is difficult to obtain by stimulating the forks when striking the prongs. However, one of the advantages of the forks, namely, high intensity at short range with low carrying power, has not as yet been attained by the electrical instrument. The fork, though loud at close range, can hardly be heard 8 inches from the ear,

8. Mackenzie, G. W.: Simulated Unilateral Deafness, Laryngoscope **39**:103 (Feb.) 1929.

preventing any possibility of the sound being carried to the opposite ear. The result obtained thus far with the Stenger test and the electrical instrument have been the same. At the present time it seems that the advantage of the Stenger test in the long run may outweigh those of the electrical instrument.

There is also an absence of symptoms and signs referable to the nonacoustic labyrinth in cases of simulated deafness. A person giving a history of sudden total simulated deafness with the absence of spontaneous nystagmus when looking straight ahead is open to suspicion. Furthermore, if the rotation tests are normal for that labyrinth, and finally if the galvanic test reveals normal reactions for both sides, there can be no doubt that the vestibular mechanism is intact and functioning normally.

The detection of unilateral deafness is important both in cases of suppuration and from a forensic standpoint. The common methods of excluding the normal ear from hearing as the moistened finger or a Bárány noise apparatus are not entirely satisfactory, for they do not nullify completely the hearing in that ear. According to Bezold, sound can be transmitted to the normal labyrinth by means of bone conduction, for he showed that when a 480 double vibration tuning fork was held in front of the ear, the labyrinth of which had been extirpated, the sound was still heard by the patient. The noise apparatus in addition has also the advantages that when placed in the normal ear, it deafens not only that one, but to some extent the diseased ear, so that if a small remnant of hearing is present, it may not be recognized because of the noise apparatus.

This test is based on the physiologic fact that during the perception of one sensation a second sensation can be perceived at the same time only when it differs within certain limits from the first sensation quantitatively or qualitatively or in both respects. The minimum difference needed for the contemporaneous perception of two sensations is called differential threshold. When two tones of identical frequency and considerable differences of intensity are introduced simultaneously, one in each ear, only the tone of the greater intensity will be heard and will be lateralized in that ear. Unilateral deafness is determined by placing a telephone receiver connected with the audiometer in the normal ear, and its threshold determined.[9] Then through a second receiver a tone of the same frequency is introduced into the deafened ear, and its intensity increased until the tone in the normal ear is suppressed and the lateralization to that ear abolished. This determines the threshold in the deafened ear. The detection of simulation is determined similarly and is based on the same line of reasoning.

9. Guttman, J.: A New Method of Determining Unilateral Deafness and Malingering, Laryngoscope **38**:686 (Oct.) 1928.

A simple test for exposing malingering in unilateral deafness is presented by Becker.[10] The equipment required consists of a rubber tube about 4 feet long with olive-shaped ear tips at each end and a fairly loud ticking watch. The principle of the test is that when a watch is pressed against a tube the ends of which are inserted in the ears of the patient, at an equal distance from each ear, the ticking will be heard equally loud in each ear. As the watch is moved along the tube away from one ear and toward the other, the sound will be lateralized in the latter and will definitely become monaural in that ear when the watch is held close to it, the distance varying, depending on the acuteness of the patient's hearing. In performing the test, the hearing is first determined in the normal ear by placing the watch tightly against one end of the tube with the other end in the ear. If the patient says he hears it, the test is continued. In the event he does not hear it, the watch is moved along the tube inch by inch until the patient says he hears it, and the distance is then noted. Both tips are then inserted into the patient's ears, and the tube is dropped behind the patient's head. The examiner then applies the watch to any part of the tube between the middle point and the supposedly deaf ear. If, for example, the patient is deaf in his right ear and the watch is placed nearer to the right ear of the patient, the sound will be carried to the left ear, providing the watch is not held beyond the distance of hearing for the left ear, which was determined at the onset of the test. In the malingerer the increasing sound in the right ear will exclude the sound in the left and on questioning he will be at a loss as to what to answer. He may say he hears nothing, exposing himself, or if he is a clever malingerer, he may state that he hears it in his left ear. In this event the examiner pinches the tube closed leading to the left ear, and if the patient still insists he hears it in his left ear, he is exposed. The tube near the normal ear may be clamped before the test is begun and if on questioning the patient states he hears it in that ear, it will be known that he is malingering. If he states he hears nothing, the clamp is then gradually loosened, and then if he continues to deny hearing anything, he again betrays himself. The test may be made with any ticking instrument, and the tubes may be of varied lengths.

Dr. John F. Callahan of Brockton, Mass., described a test similar in principle some years ago.

These tests are based on the same principle as the Stenger test in that a louder (nearer) source of sound introduced into one ear masks or drowns the sound entering the other ear. The Stenger test (or its modification by Dr. W. A. Wells) is reliable and requires much less

10. Becker, B. M.: A Simple Method for Exposing Malingering in Unilateral Deafness, Arch. Otolaryng. 9:440 (April) 1929.

apparatus than the tubes employed in these various modifications. All that is needed is a pair of balanced forks of the same pitch using either *a-1* (435 double variations) or *c-1* (256 double variations).

The mechanism for the detection of unilateral deafness purposed by Becker [11] consists of a shallow cup of a Bowles stethoscope attached to a piece of rubber 12 inches long. At the other end is attached the bifurcated rubber or metal piece of the stethoscope, and to each end of this tip is attached a soft rubber tube, one 12 inches and the other 24 inches in length. The test is performed with a ticking instrument such as a watch, care being taken not to have one too loud so as to be heard outside the tubes, or not loud enough to be heard the length of the tube. The principle of the test is based on two facts: first, that when two tubes of unequal length are used, the sound will be lateralized on the side of the shorter tube; and second, that when one compresses the longer tube through which no sound reaches the ear, a decided change on the opposite ear will be noticed, probably because binaural hearing has been converted into monaural hearing.

In performing the test, either the direct or the indirect method can be used. In the indirect method, the examiner stands behind the patient. The shorter tube is placed in the normal ear, and the longer tube is inserted in the deaf ear. The watch is applied to the stethoscope, and the patient is asked where he hears the sound. He will state in the good ear. The patient is then asked to tell when he hears a change in sound, and the longer tube going to the deaf ear is then compressed. If he states that the sound has changed and seems to approach nearer the ear drum, the examiner knows that the patient is malingering, for if the other ear is deaf no change in sound should be perceived when the tube going to the deaf ear is clamped. If he states that there is no change in sound, the direct method is tried. The tubes are reversed, the longer inserted into the good ear, the shorter into the deaf ear. With the watch placed against the stethoscope, the patient is asked if he hears the sound. If he states that he hears nothing, one knows that he is malingering, because if he is deaf in one ear he should hear the sound in the good ear even with the long tube. If he states that he hears the sound, the tube going to the good ear is gradually compressed, and if he states that he still hears it, he is exposed. When the long tube which leads to the good ear is compressed by the examiner, the patient, if he is malingering, will give conflicting answers and thus expose himself.

This method also employs to a large extent the principles mentioned in discussing Becker's other paper. Why use complicated mechanisms when the simple Stenger test gives excellent results and merely requires

11. Becker, B. M.: A Novel and Simple Method for the Detection of Unilateral Deafness, Laryngoscope **38**:677 (Oct.) 1928.

one or two tuning forks for its performance? These forks likewise are used in other tests, and thus serve two purposes.

Grant [12] presented a method devised by Hartmann, in 1898, for obtaining charts of the hearing power for a series of tuning forks. The orginal instructions were to determine the length of the time in seconds that each tuning fork was heard by the patient, after the duration with these forks for a normal person had been obtained. To obtain the percentage of normal duration of hearing to which this corresponded, the amount was divided by the normal and multiplied by 100. This was modified by taking the differences in hearing in seconds between the normal and the patient and then charting it on a specially ruled chart. The estimation of this actual difference in duration of hearing has an advantage when employed for the purpose of obtaining the percentage of actual hearing ability instead of the mere duration of hearing, from which it differs considerably. According to Hartmann's method, it is assumed that percentage duration of hearing corresponds to percentage of actual hearing power, which could be true only if the tuning fork died away by equal amounts every second as in arithmetical progression. It is, however, well known that this "dying away" is at first more rapid, diminishing with each successive unit of time in geometrical progressions; i. e., with each successive unit of time, the amplitude has to be divided by a constant quantity making the process one of division instead of subtraction. The experimental determination of the constant K for any tuning fork can be carried out at any physical laboratory, and the calculation can be made by any one accustomed to use logarithms. The procedure and physical considerations are presented in detail. It is difficult to state whether the practical value of these determinations compensates for the time occupied. However, there is no question that these investigations constitute a step toward accuracy and are therefore worthy of consideration.

At the International Otological Congress held in Boston in 1912, Dundas Grant presented the important facts relative to the dying down or "decay" of vibrating tuning forks. Judging from the statements one often meets in reading papers on functional hearing tests, many otologists seem to be ignorant of these facts. A restatement of the logarithmic progression is therefore welcome.

Some years ago, working with the Webster phonometer, Sonnenschein [13] found that the greatest intensity of vibration emanates from the broad or outer surface of the prongs of the tuning fork, a little less

12. Grant, Sir James Dundas: Quantitative Tuning Fork Tests in Relation to the Rate of "Dying Down," J. Laryng. & Otol. **44**:381 (June) 1929.

13. Sonnenschein, R.: Some Very Accurate Measurements of the Amplitude of Vibration of Tuning Fork Prongs, Ann. Otol. Rhin. & Laryng. **38**:197 (March) 1929.

from the two narrow surfaces, less from the ends and least of all from the edges or angles formed by the broad and narrow surfaces. It was suggested by Mr. B. E. Eisenhour that probably the shape of the prongs, the distance between the prongs or the relation to the width of the prongs may produce some difference in the relative intensity of one or the other side of the prongs. In view of this suggestion the results obtained in 1924 were carefully checked. The amplitude of vibration was observed through a microscope eyepiece in which there was a scale on which the amplitude or excursion of the prongs could be definitely seen. The fork was activated electrically, and the intensity of sound was measured with the sound meter of Eisenhour.

The results noted were the same as those obtained before when the same forks were used. The shape of the Riverbank fork, and the distance between its prongs were somewhat different from those of forks used in the previous tests; this fork showed a greater intensity from the narrow surfaces than from the outer surfaces of the prongs. Therefore the shape of the fork and the distance between the prongs exert considerable influence in determining which surface of the prongs emits the greater intensity of sound. The longer the distance between the prongs, the more sound can escape. Since there is, however, only a slight difference in the intensity of sound from the outer surface and that from the narrow surface of the prong when held parallel with the ear the same statement made in the original paper still holds true; i. e., "that even though in most forks that I have used the outer surfaces give slightly more intensity than the narrower ones, from a practical standpoint it will make essentially no difference which of these surfaces is presented to the ear provided that the examiner always uses the same method in all his cases so that he obtains uniform and comparable results."

The mechanical aids [14] to hearing are divided into two groups: the electric and the nonelectric. The nonelectric group includes devices such as horns, speaking tubes, conches, auricles, etc., which depend for their effectiveness on the collection and amplification through resonance of the sounds of speech, so that they are conveyed to the ear in intensified form with the least possible distortion. The chief objection to these is their conspicuousness, weight and unwieldiness. In connection with the use of electric hearing aids, Fletcher groups the hard of hearing into four classes: the first, those who hear the conversational voice at a distance of from 2 to 4 feet and who show a loss of less than 30 sensation units in the better ear throughout the range of the human voice; second, those with a loss of from 30 to 60 sensation units for the same pitch

14. Newhart, H.: Aids for the Hard of Hearing, Laryngoscope **39**:248 (April) 1929.

range; third, those with a loss of from 60 to 80 sensation units, and fourth, those with a loss of more than 80 sensation units. The subjects in the first two groups require an instrument of weaker intensity which can be increased for distances; those in the third group require a more powerful instrument, while those in the fourth group require instruments of special construction with the disadvantage of increased distortion and lessened portability. The larger models, which are not portable, are used for teaching the deaf or in the home or places of business. The telephone companies are now prepared to supply, on a rental basis, special equipment to amplify the sounds of the receiver so that those with considerable loss of hearing can use the telephone with satisfaction. The attitude of the otologist toward these hearing devices should not be to regard them as something to be employed as a last resort, but rather to suggest these aids together with the study of lip reading before the patient becomes severely deafened, thus losing much valuable time and requiring greater effort to reeducate his ears. With the early use of these devices the patient learns to exclude the adventitious sounds they produce, just as the normal person learns to suppress outside noises from lifelong habit. The adventitious sounds are amplified equally with the useful sounds of speech, and constitute the greatest obstacle for the beginner using the electrical device. The patient should be encouraged in his attempts to use the instrument over a considerable period until he acquires the skill to suppress these adventitious sounds, making the advantages greater than the disadvantages. The great advantage of proficiency in lip reading as a supplement to the instrumental devices is not adequately appreciated. It is really indispensable to the hard of hearing. Lip reading enables those with severe loss in hearing to supply the elements of speech which are not heard with the hearing devices. As soon as the otologist discovers a permanent or threatened handicap, he should insist on early study in lip reading. The promotion of a national movement to encourage the proper enunciation and pronunciation of the English language would be of great assistance to the hard of hearing.

The newer instruments are now much lighter, more compact and practically inconspicuous, with the price ranging from $25 to $100, depending on the amplication required. Final purchase should be made only after a thorough trial and a careful otologic examination, made more valuable by the addition of an audiogram. No hearing device can remove the pathologic causes of deafness, and every otologist should vigorously combat any claims or statements leading to the inference that the use of electrical hearing devices has a curative effect. The improvement in the ability to hear speech sometimes noticed following the use of a hearing aid is the result of the acquisition of greater skill in the interpretation of speech sounds, and not to an actual increase in acuity for pure tones.

On the other hand, subjecting the hearing apparatus to loud sounds for a prolonged period in the hope of improving the hearing should be condemned as harmful. The otologist's responsibility does not terminate with the prescribing of lip reading or a mechanical device. As long as a remnant of hearing remains, he should impress on the patient the importance of periodic otologic examination, avoidance of upper respiratory and focal infections, improper uses of tobacco, alcohol, etc., in order to preserve if possible what hearing he has, so that he may retain the highest possible hearing efficiency. The otologist should also encourage his patient to become associated with the local organizations for the hard of hearing to aid him in rehabilitating himself as well as overcoming that inferiority complex, lack of confidence and depression which so often overcomes him. With the properly selected instrumental aid, and the mastery of lip reading, the average hard of hearing person has conquered to a great extent his handicap and should without fear be able to assume his share of responsibilities and joys of life.

With reference to mechanical aids, it should be remembered that Dr. Paul Sabine of the Riverbank Laboratory (Geneva, Ill.) showed some years ago that with the exception of the largest (hence most cumbersome) types of horns, the hand placed against the edge of the auricle with the concavity forward acts just as well as a collector of sound waves and as a resonator. A few years ago I happened to obtain a few tubes made of copper which were light, easy to carry and gave a tremendous aid to hearing. They were made in England and were rather expensive and difficult to get, but seemed to be the best hearing tubes I have ever known.

With reference to the electrical hearing devices, all otologists realize that there are several defects or disadvantages. They are rather high priced, there is difficulty with batteries, some are heavy and most of them produce annoying adventitious sounds. Some forms of apparatus give best results when there is impairment of conduction apparatus of the middle ear. For involvement of the inner ear or auditory nerve little benefit can be obtained with these electrical devices. I believe that the combination of, first, a careful examination of hearing in order to make an absolute diagnosis so as to formulate the prognosis and to decide which type of hearing device may help; second, selecting such apparatus in a most careful and judicious manner, and third, having the patient study lip reading as soon and as intensively as possible should mitigate in a considerable measure at least the distressing disabilities of the unfortunate hard of hearing.

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Correspondence

"A NEW OPERATING ATTACHMENT FOR CATHETERIZING THE EUSTACHIAN TUBE"

To the Editor.—In the October, 1929 issue of the ARCHIVES there appeared an article " A New Operating Attachment for Catheterizing the Eustachian Tube," by Robert M. Colbert of New York. He describes this as a new device which was developed with the assistance of Mr. Reinhold H. Wappler. The principle of this attachment does not differ from ones outlined to Mr. Reinhold H. Wappler in 1926, a description of which has appeared in several publications, including my own communication in the December, 1928 issue of the ARCHIVES OF OTOLARYNGOLOGY. Dr. Colbert, in his article, claims priority in the development of a combined instrument for catheterizing the eustachian tube under direct vision. This instrument consists of a cannula which can be attached to a nasal pharyngoscope. He states that the instrument was developed by him through the aid of Mr. Wappler during the period of 1921-1923. I have not been able to find in the literature a description of any sort of such a combined instrument for catheterizing the eustachian tube under direct vision prior to my own publication in 1926 (accepted for publication, Feb. 27, 1926). In 1927, I received a communication from Mr. Reinhold H. Wappler, which read as follows: "We are informed that your catheterizing contraption is inoperative and the specialist who so informs us has designed an improved attachment."

LOUIS K. PITMAN, M.D., New York.

Abstracts from Current Literature

Ear

MORTALITY OF CHRONIC MASTOIDITIS. M. BIGLER, Ztschr. f. Laryng., Rhin. **18**: 213 (June) 1929.

Bigler describes the case history of a man, aged 59, in whom complications of a simple chronic mastoiditis proved fatal. When he first came to the clinic, he was vigorous and seemed healthy, except for the chronic condition of the ear, which had developed after an attack of measles when he was a child. However, a discharge was noted from his ear, and he had ozena. After treatment with boric acid for three weeks, the condition of the ear was greatly relieved. The flow of pus was inhibited, and his hearing improved. From his nasal secretion a vaccine was prepared, which was injected subcutaneously. Three years later, the patient returned to the clinic, complaining that his ear was again suppurating; treatment for a period of from three to four weeks relieved the condition. Six weeks later, however, he again returned, suffering from the previous trouble. Microscopic examination of the pus disclosed pneumococci. His general condition was good, and he continued with his work, being given ambulatory treatment. Within two weeks, however, he complained for the first time of neuralgiform pain over the left temporal bone. Roentgen examination showed that the inner ear was intact on both sides. In the left processus mastoideus, however, a circumscribed dense area was seen, in which the meshlike structure was indistinguishable and a sclerotic cortex was noted. The leukocyte count was 9,000 per cubic centimeter with deviation toward the left. The patient refused surgical intervention and returned home. His condition became rapidly worse, and two days later he was brought to the clinic almost in coma. Operation showed an exceedingly thick cortex. The small cellular spaces of the processus mastoideus were filled with pus, likewise the apex. The antrum was small and narrow and was filled with granulations containing pus. Puncture of the sinus disclosed blood. On the tegmen antri, a large abscess with destruction of bone was noted. The dura was discolored over the region of the temporal lobe. The tympanic cavity was filled with pus and granulation tissue. The patient died the next day. Meningitis had obviously been caused by the retention of pus due to the closing of the narrow antrum with granulations. On the basis of his experience in this case and a review of the literature, Bigler points out that aside from the condition of the tympanic membrane in simple chronic suppurations from the middle ear, the state of pneumatosis in the processus mastoideus and the result of bacteriologic examination must be considered in prognosis of the disease.

Pharynx

INDICATIONS FOR AND TECHNIC OF TONSILLECTOMY. J. PORAS, Ztschr. f. Laryng. Rhin. **18**:82 (March) 1929.

According to Poras, whose personal experience within the last few years covers more than 1,800 tonsillectomies, none of which had an unfavorable outcome, the tonsils are not of vital importance, and they can be removed at any time without danger to the patient. He states that the tendency toward sore throats is a sufficient indication for their complete surgical removal. The preferred type of operation in children is according to Sluder's method; in adults, tonsillectomy is advised with a blunt raspatory. For the purpose of checking venous bleeding, the use of a hemostatic drug is advised, given locally by insufflation, subcutaneously or by intravenous injection. Arterial hemorrhage is stopped by ligature around the vessel. For alleviating the pain caused by the wound, tampons soaked with antivirus are allowed to remain for a short while in the wound cavity; they have proved most efficacious. If the operation is done on account of sepsis or a sug-

gestion of sepsis, a favorable result can be expected only if not more than one or two chills have occurred and if ligation of the jugular vein is done coincident with the tonsillectomy. Care should be taken that the ligature is made as far down as possible below the phlebitic portion of the vessel; in this case, only operation may save the patient's life. Otherwise the prognosis is almost invariably serious.

COMPLICATIONS FOLLOWING TONSILLECTOMY. H. CLAUS, Folia Oto-Laryngol. **19**:89 (Nov.) 1929.

From the consideration of thirteen cases reported within the last two years, in nine of which death occurred, Claus points to the danger of infection. In many cases it may be due to penetration of the infected tonsil and the still healthy muscular tissue with the same needle on injection for local anesthesia, thus creating a new focus of infection. Claus also considers operation in an acute stage of tonsillitis dangerous and advises that a period of four weeks be allowed to pass before tonsillectomy. In case symptoms of general infection are noted, immediate tonsillar mediastinotomy should be done, together with injection of vaccine. Ligation of the veins should go hand in hand with drainage of the connective tissue. Two patients in whom these interventions were done could be saved.

Nose

INCIDENCE OF NASAL POLYPS IN OZENA. O. HIRSCH, Monatschr. f. Ohrenh. **63**:605 (June) 1929.

On the basis of a review of the literature and his own experience in forty-two cases, Hirsch says that most polyps do not arise in the middle nasal duct as has been believed heretofore, but that their origin is usually in the accessory sinuses. They are not connected with purulent discharge from the nose, but their origin may be traced to catarrhal inflammation. Recurrence may be explained by the fact that this condition does not change as rapidly as has been believed and that partial incarceration of the mucosa and extension of the inflammation into this region stimulate the formation of a new polyp. The maxillary sinus rather than the ethmoidal sinus is the site of predilection of polyps, according to Hirsch.

RELATION BETWEEN NOSE AND SEXUALITY: CORRELATIVE FUNCTION OF NASAL MUCOSA. N. KARPOW, Monatschr. f. Ohrenh. **63**:758 (July) 1929.

On the basis of his clinical experience, a review of the literature and animal experiment, Karpow states, that pathologic processes in the nose are not to be called "local" ones only, but that they react on the entire organism. He points out that many gynecologists have noted the relation between the genital organs and the nose. Of especial interest is the therapeutic effect of cocaine applied to the nose in disorders of the genital tract. The results of forty experiments on rabbits, guinea-pigs and dogs showed that extirpation of the inferior conchae in young animals causes deficient development of the genital tract. He was able to perform resection of each side when the operation was done in two times. In weak concentration aqueous extract of the inferior or middle conchae of a guinea-pig stimulates contraction and causes increase of muscle tonus in the isolated uterine horns of the same animal; a more concentrated solution induces tetanic contraction of this organ. The action of the extract is intensified in the uterus of pregnant animals or those which had already been pregnant. Extract of the mucosa, bone or muscular tissue from any other part of the nose does not have any effect. The result of these experiments convinces Karpow that the tissue of the conchae (especially of the inferior one) contains a substance which has a specific action on the "nerve-muscle" system of the uterus. Whether this action is effective in the living organism, its mode of transmission or the nature of this substance are problems of further investigation.

CONTRIBUTION TO THE PHYSIOLOGY OF TONSIL. T. MURATA, Ztschr. f. Laryng., Rhin. **18**:70 (March) 1929.

Murata discusses the relation between the tonsils and the adjacent lymph glands and ducts. On the basis of his experiments on twenty-seven patients made by injection of india ink before tonsillectomy for studying the defense mechanism against penetration of corpuscular elements into the tonsils and a review of the literature, he draws the following conclusions: India ink spread evenly over the surface of the tonsils does not penetrate into the stroma. Neither does it do so if injected into the capsule or the surrounding tissue. It may be found in the excretory lymph ducts. India ink injected into the subepithelial layer of the tonsils usually remains around the site of injection. Small amounts, however, penetrate into the center within the lymphoid tissue and the follicular connective tissue, and in rare instances it can be seen in the epithelium. Murata states that injected into the tonsillar tissue, india ink is spread diffusely and with almost equal distribution in the lymphoid tissue and connective tissue within the tonsil. However, it then drains toward the periphery in a netlike manner and is increasingly absorbed by the cells. There may be a resistance against penetration of foreign bodies between follicle and diffuse lymphoid tissue and between lymphoid tissue and interfollicular connective tissue or epithelium. The india ink present in the epithelium forms circumvallate heaps of small or larger granules.

COCAINE-EPINEPHRINE CORYZA AS THERAPY. H. STERNBERG, Ztschr. f. Laryng., Rhin. **18**:103 (March) 1929.

Sternberg points out that disorders in the normal permeability of the mucous membrane of the respiratory tract (and also the ears) are responsible for many diseases. A decrease of this permeability in inflammation and likewise vasomotor diseases of the mucosa of the nose and accessory sinuses cause local disturbances (such as headache and obstruction of the nose) and lead to general disorders. Although Sternberg is against the artificial production of coryza by painting of the mucous membrane with cocaine-epinephrine solution in vasomotor disorders with or without headache, he considers inflammations of the tissue (decreased permeability with all accompanying conditions) as demonstrating the value of the treatment. The cocaine-epinephrine coryza initiates a decrease of swelling (dehydration) of the nasal mucosa and that of the accessory sinuses. Thus with the increased excretion of fluid the toxins and products of decomposition from the mucous membrane are washed out, and the patient is relieved from headache and nasal obstruction.

SUBMUCOUS HIGH RESECTION OF NASAL SEPTUM. K. TAKAHASHI, Folia Oto-Laryngol. **19**:22 (Nov.) 1929.

Takahashi gives a full description of the technic he has developed and applied successfully during the last seventeen years, for restoring normal conditions in pathologic nasal cavities. The entire operation consists of three main parts: first a plastic operation of the lower nasal conchae, then reduction of the lateral nasal wall and, lastly, the submucous high resection of the nasal septum. For these methods he also devised certain instruments. The main advantages of the last-mentioned operation lie in the rapidity (from two to three minutes) with which it can be done and in the preservation, to a great extent, of the mucous membrane of the septum through the use of the entire handle of Takahashi's straight elevators during detachment. In less than 1 per cent of 2,400 submucous resections, tearing of the mucous membrane occurred. Sinking of the bridge of the nose is prevented by beginning the resection from 4 to 5 mm. beyond its front part. A subsequent operation, done with this technic on a septum which has remained bent after the first operation, gives the same favorable result. Takahashi reports that in about 10 per cent of his cases, he also resected the tuberculum septi so as to restore normal ventilation. The complete removal of all glandular tissue with knife and cutting forceps leads to rapid healing and favors the permanent result thus obtained.

CONTRIBUTION TO SURGERY OF THE HYPOPHYSIS. A. BLUMENTHAL, Folia Oto-Laryngol. **19**:40 (Nov.) 1929.

In Blumenthal's patient, a man, aged 55, a diagnosis of disease of the hypophysis had been made six years previously. Acromegalia, hypogenitalism, polydipsia and polyuria were present, also bitemporal hemianopia with atrophy of the optic nerve. Roentgenography showed a widening of the sella turcica and flexion of the processus clinoidei. The condition had become worse and it was decided to relieve the intercranial tension by surgical intervention. Ten days before the operation, ligation of the carotid artery on the right side was done to prevent extensive bleeding. General anesthesia with tribromethanol was given and was supported by local anesthesia with procaine hydrochloride. A vertical incision was made near the median line of the nose, separating the tissue from the root of the nose to about the apertura piriformis. A second incision was made from the top of the first one toward the middle part of the infra-orbital border. The underlying bone was resected, thus opening medially the frontal sinus and the right maxillary sinus. The right middle and upper part of the right inferior turbinals were also resected; likewise the ethmoid bone with the lamina papyracea. A tampon was placed in the nose, but there was little bleeding. The operative field was illuminated by means of a reflector. It was seen that the roof of the sphenoid sinus was destroyed by atrophy and from its upper part, pus flowed out. Tamponade was done and a permanent tampon laid in the nose. Symptoms of severe cerebral irritation were present, but no signs of meningitis. The skin wound healed as did the interior of the nose. Postoperative treatment with roentgen and radium irradiation was given. The patient's general condition was considerably improved, although vision of the right eye had further decreased, due to the atrophy of the optic nerve.

SIMPLE AND EFFICIENT METHOD FOR TREATING OZENA. H. HEERMANN, Folia Oto-Laryngol. **19**:50 (Nov.) 1929.

The aim in the treatment for ozena, according to Heermann, is to apply a method which exerts effective irritation and can be applied by the patient himself; also one which has no harmful after-effects or in any way disturbs the patient. The old method of treatment by irrigation is still valent, although useless for severe cases. Heermann reports that for the period of one and one-half years he has applied successfully a method of treatment by congestion. Within this time only thirty-two severe cases had been noted, whereas formerly up to 9,200 cases were observed each year. Heermann uses a glass tube with a balloon-like widening, to which a rubber balloon is attached at a right angle. The latter has a diameter of about 6 cm. and exerts a pressure of from 50 to 160 mm. of mercury. This treatment is first given by the physician at 50 mm. pressure, till the patient has become accustomed to the suction. If the uvula cannot be closed, this may be done with help of a spatula by an assistant. Treatment should be given till the patient has learned to breathe by mouth without the uvula opening and his saying "tick-tick." In some patients this may be done after one or two sessions, in others after ten or more sessions. The patient should then learn to hold the glass tube to one nostril and close the other; the rubber ball may be pumped with the free hand. This treatment is advised daily for from ten to fifteen minutes while reading the newspaper. Heermann points out that permanent improvement does not persist, but that the treatment does not propose to be curative. He also advises this method in treatment for dry persistent naso-pharyngeal catarrh and severe autophony.

Society Transactions

AMERICAN OTOLOGICAL SOCIETY

ROBERT SONNENSCHEIN, M.D., *Reporter*

Sixty-Second Annual Session, Atlantic City, N. J., May 22, 23 and 24, 1929

J. GORDON WILSON, M.D., *President, in the Chair*

Friday Morning Session, May 24, 1929

(Concluded from p. 710)

OTOLOGIC COMPLICATIONS OF SWIMMING IN SUMMER CAMPS. DR. FREDERICK T. HILL, Waterville, Me.

An individual study was made of 1,235 students from fourteen selected camps. They were all carefully studied at the beginning of the season. Those giving histories or showing any evidence of ear, nose or throat trouble, such as might predispose to otologic complications (36.5 per cent of the total), were grouped according to the presenting pathologic process, and restrictions based on their clinical pictures were imposed on water activities. One and twenty-nine hundredths per cent of the students had chronic suppurative otitis media and sinusitis and were advised against any immersion in the water; 11.17 per cent were placed under partial restrictions, depending on the conditions. The remaining 24 per cent were not restricted, but were carefully watched by the camp physicians and instructed as to behavior in the water. These students were followed during the summer and a careful check-up was made at the close of the season. No complications were encountered from the first group. There were two cases of acute otitis media from each of the last two groups, a much lower incidence than in any previous years, and a total absence of any serious cases. There were also five cases of acute eustachian salpingitis. Practically all of these cases resulted from swimming while the student was afflicted with head colds, the greatest source of ear trouble at these camps. The bacterial content of the water was studied but was not found significant. Camp routine seemed to take care of the extrinsic factors mentioned by Taylor. All types of swimming were practiced, but it was all under careful supervision, especially as to proper breathing. The elimination or restriction of the hazardous cases showing pathologic changes or infection greatly reduced the incidence of complications.

DISCUSSION

DR. THOMAS J. HARRIS, New York: I have had the privilege of looking over Dr. Hill's paper, and I want to speak in praise of the painstaking investigation that he has conducted. His study of more than 1,300 cases cannot help being fruitful in its results. He speaks of the relation of bathing to aural and sinus complications, and this is important. I think that in this paper Dr. Hill has drawn attention to some of the important economic aspects of this specialty. Dr. Fenton and Dr. Taylor have given us the results of their studies for a number of years, and they point out the fact that these complications can occur in fresh running water in which bacteria presumably are absent. The element of fatigue has been emphasized. I want to agree heartily with this point. I think that one hour is a long time to allow boys and girls to stay in the water. Another point that Fenton stressed in his observations is that we should consider the nasal and sinus complications as well as the aural disease that may be present. When there is a latent sinusitis this may be lighted up by a good deal of bathing.

Latent bacteria in the nose become active as a result of the bathing, and a latent sinusitis may become an active condition. The association with the ear is evident. I have been impressed with the added risk of abnormal conditions in the nose. To illustrate, a deflected septum is a potential factor in causing sinus disease, and is a menace in bathing. What Dr. Hill said about acute rhinitis being a contraindication for bathing is true. I can agree with what Dr. Hill said about diving, only I do not think that he made it strong enough. I prohibit diving, except for one straight dive on entering the water. Out of Dr. Hill's paper as a whole there is one chief conclusion to be drawn, and that is the great benefit of a careful study of the nose, throat and ear of all patients and the preventive measures that should be and are being taken by camp physicians in the elimination of potential risks. Dr. Hill has had only four cases of otorrhea during the summer. That is a magnificent showing. If we can get camps to recognize this and see the necessity of preventing economic loss, the excellent results which he has presented may be more generally secured.

DR. J. HOLINGER, Chicago: I heartily coincide with Dr. Hill's views and believe that this society should take a stand in regard to two or three points. It seems to me that it is in the line of prevention of deafness to make it known that diving is dangerous to the ears and even to life. The public and even many physicians do not know how quickly a person becomes unconscious when cold water enters the ears. Dr. Hill's propaganda is timely. Another point concerns the method of swimming. The present instruction tends to keep the head too much submerged. Perhaps one cannot swim as fast, but more safely, with the head out of water. The constant effort against the water forces the air out of the canal and water takes its place. A third and important point is that in the presence of a slight cold one should keep out of the water altogether as regards both swimming and the tub bath. True, one feels clearer after a bath for an hour or two, but later on the cold becomes worse and lasts much longer. Writers have called attention to this fact in a number of papers. Any form of hydrotherapy is contraindicated during the presence of a cold.

DR. S. MACCUEN SMITH, Philadelphia: Most of us have been called on from time to time to advise whether children should be allowed to swim. Most of the patients who develop aural disease do so by diving, so I feel that this part of swimming should be limited to those with normal ears and even then the organ of hearing should be protected in the usual way. Most young children are well satisfied if they are allowed to put on their bathing suits, play in the sand, have the benefit of both air and sun and just before leaving the beach go into the water without wetting their heads. Unquestionably, much infection is found in the various swimming pools, notwithstanding that every effort is made to keep them clean and as free as possible from bacterial invasion. I served on a committee of investigation a few years ago and although the water was changed frequently and in some pools run continuously, the children had "colds," became ill and with about the usual frequency had involvement of the ear. I believe that the length of time the children stayed in the pools (and this applies also to bathing in lakes and at the seashore) had much to do with their illnesses and the complications resulting therefrom, from the fact that they became more or less exhausted and this lowered their resistance and recuperative powers. The various rubber devices to keep water out of the ears have been unsatisfactory to both adults and children. The object is better attained by smearing a small plug of cotton with petrolatum, placing this in each ear and then wearing a close cap. The truth of the matter is that the vast majority of cases of aural involvement occur from the attempt of the bather to clear his nose of water, thereby blowing infection through the tube into the tympanic cavity.

DR. J. GORDON WILSON, CHICAGO: I should like to ask Dr. Hill what plug he thinks is most efficacious.

DR. D. HAROLD WALKER, Boston: I think that this is a most timely subject. This is the season when summer camps in New England are in full swing. It is an institution which has come to stay. The children go to camp to learn

to swim, and they do not care for camp life unless they are allowed to swim, so that we must give the question of swimming our careful attention. Personally, I believe that every person should learn to swim. I should not be here myself if not for the fact that my daughters have life-saving medals and were able to put their swimming to the test. Dr. Hill spoke of the bacterial content of the water; he mentioned 1,650 per cubic centimeter; that is very high. I think that in a case like that there should be an investigation, to determine the type of bacteria. The Maine Lakes have clean water. I was struck by the mention of prior operations on the tonsils. It shows how much more carefully this work should be done. Fifty per cent of poor results is much too high. I think that in giving advice to our patients we should go into details as to how to prevent water from entering the ear. Often in cases in which a child has had a dry ear for a long time, he goes to the beach, and after bathing comes back with a discharging ear. We should show our patients how to use the rubber ear plugs, or petrolatum cotton, with a rubber cap over the head. I think that the time a child is allowed to swim is important. One hour of swimming is fatiguing. It is the only sport in which the body is suspended in a medium without support, and consequently calls for more muscular effort than we realize. I think that if the time were cut down to a half hour twice daily the result would be much better. I think that the question of diving is important. I had one patient, a young man, who dived off a float. He burst his ear drum, became dizzy and when in the water lost his power of orientation. Finally he touched bottom and was guided to the shore. It was hours before he got home. He had suffered a bad rupture from the periphery to the umbo. I have often wondered if accidents of this kind may be a factor in cases of so-called cramps which so often occur in wonderful swimmers. In regard to cases of acute meningitis, I have seen one case of death which occurred after the person dived from a high float. The person caught cold, developed sinusitis and then meningitis. Diving is a dangerous sport. Swimming is necessary, but diving is not.

Dr. F. T. Hill: I heartily agree with what has been said about diving. I feel that the observation made by Dr. Fenton that many cases of death in the water, so-called cramps, are due to a labyrinthine stimulation is undoubtedly correct. I was talking to a swimming instructor at one of the camps, and while he did not know anything about the labyrinth, he was much opposed to the form of swimming in which the head is submerged, and to plunging for distance. This work was taken up in selected camps and we had pretty good cooperation, but in one camp not in this list in which there was no regular medical supervision we had ten times as much complication. Diving is a menace, but camp authorities will not stand for too much restriction. The same thing applies to fatigue. These youngsters are usually in the pink of condition, able to hike several miles a day and will not tolerate having their swimming time curtailed. The average time in camps is an hour, but they sometimes have two half hour periods. In one lake in which there was a high bacterial content, there was decayed vegetable matter, but no *B. coli* were found. A fungus growth appeared for the first time last year. These youngsters are often hard to handle and want to go into the water whether they have colds or not. The danger I think is in the prodromal stage. The danger Dr. Holinger spoke of may be minimized I think if the children are carefully supervised and taught to breathe properly when swimming. The question of fatigue is important. People will go to a swimming pool to swim after a hard day's work. This adds fatigue to the risk. As regards plugs, cotton moistened with petrolatum or hydrous wool fat is preferable. Rubber plugs might irritate the canal.

The Use of the New Magnesium Alloy Forks. Dr. Robert Sonnenschein, Chicago.

Although many appliances have been devised for use in functional testing of hearing, tuning forks still remain in many ways the best, most dependable and easily accessible instruments. Unnickeled forks tend to rust on exposure to the

air or handling with moist fingers. Nickeled forks sooner or later give rise to adventitious sounds when the nickeling peels. A complete series of forks, from C-2 (16 double vibrations) to c-5 (4,096 double vibrations), has been perfected by Mr. B. E. Eisenhour of the Riverbank Laboratory, Geneva, Ill., of an alloy consisting of 95.6 per cent magnesium (which has a specific gravity of 1.7), 0.4 per cent manganese (having a specific gravity of 8) and 4 per cent aluminum, with a specific gravity of about 2.7. The alloy, therefore, has a specific gravity of about 2.2; in other words, about one-third that of steel, which is usually 7.7. This metal has two great advantages, first, that it is rust proof and secondly, that it is light in weight. In testing the lower pitches, the hands soon tire because of the great weight of the low pitched steel forks, especially those that are provided with weights. The price of these forks is a little less than that of the best German forks, such as the Edelmann series. They do not seem to be any more brittle when properly handled, as all good forks should be.

These forks can be supplied with the "constant" of decrement or dampening, and may thus be used for determining the loss of hearing figured in sensation units just as is done with the audiometer.

Magnesium forks, just like the medium and low pitched steel forks, have decided overtones when struck, but these may be eliminated by the use of weights as is done with steel forks, or by placing about the ends of the prongs thin but fairly wide bands of rubber.

The highest pitched, c-5 (4,096 double vibrations), magnesium alloy fork does not vibrate long enough for all purposes, but the other forks of the series do well for testing both air and bone conduction. When one simply desires to see whether the patient can hear the tone of c-5, the magnesium fork serves well, but not if one wishes to test actual duration of hearing for this pitch.

Whether the new magnesium alloy forks will ultimately largely displace steel forks in otologic practice cannot be positively stated at present, for it will require considerable experience on the part of many otologists to settle this question definitely especially with reference to the highest tone, c-5 (4,096 double vibrations). It seems, however, that we have here a satisfactory solution of the problem of supplying forks made of a metal which is rustproof, and the weight of which is such that long-continued testing does not prove as fatiguing as it does with the heavy steel forks. Hence these new forks have some decided and desirable advantages to their credit.

DISCUSSION

DR. G. E. SHAMBAUGH, Chicago: One point has come up in this discussion and that is the question of the duration of the vibration of the fork. I prefer a fork that dies out slowly. I do not see the disadvantage in the prolongation of the sound. In applying the Rinne test I get a more accurate division and can distinguish better between bone and air conduction. You can note by the duration whether the sound is heard before the ear or behind it.

DR. MACFARLAN, Philadelphia: I appreciate being asked to speak before the Otological Society, chiefly because I am interested in forks and the possibility that we will still hang onto the forks. I am enthusiastic about audiometers too, but I do not see how we can discard forks. I agree in the main with Dr. Sonnenschein, because long experience with forks has brought about recognition of facts that are irrefutable. The committee has done good work in getting the Riverbank Laboratory to work on the production of a fork that is light and useful, especially when one has to test all morning. This fork is more desirable than the foreign forks, and I am glad that it is an American product. I do not believe that Dr. Sonnenschein brought out the importance of the matter of time. I am less concerned about the matter of pitch than Dr. Sonnenschein. It does not matter to me whether my forks are 256 or 240. I know the general region in which I am testing. Dr. Fowler developed the fact that there were no sharp dips in the auditory perimetry. The standardized fork manufactured by the Standard Instrument Company (the one in which Dr. Mackenzie was interested) was standardized to a very exact pitch. We have no difficulty with the continuous range audiometers in determining

the pitch of the fork. If my steel forks get rusted, I have to renickel them to get the same pitch, but I do not mind if they get a little higher or lower, as long as the hearing time, fifty-five or forty seconds, is the same, because if not, it would alter my record keeping. When I hit the forks with a pendulum blow the standard time is the same. That gives a standard hearing time, fifty-five seconds for air and thirty seconds for bone, which is the normal hearing. In regard to the overtone, fortunately that is not as strong as the fundamental, but Dr. Sonnenschein is right in being on the lookout for the reporting of that tone instead of the fundamental tone of the fork. If you make the patient sing the note he hears you can tell whether or not it is the overtone. As to the overtones caused by rust, they are so minute, so transient, that they are of no importance. Rubber bands will give out overtones, but any dampening whether by weights or by bands will not alter workable time. One should allow an interval between testing air conduction and bone conduction. This can be done with a fork that vibrates for one hundred and fifty seconds. The standard Mackenzie forks vibrate for two minutes. That takes too long to make the tests. The Alexander forks are 110 air conduction and 70 bone conduction but when making a series of tests 60 air conduction and 50 bone conduction is long enough. This gives a faster working time. Another point about the long time fork is that one is apt to get tone images. This should be avoided, but in children and in adults who have been deaf for a long time one is not apt to get tone images. There is another point about long time forks, that they die out at the end very slowly. Short time forks die out very suddenly. The big low tone forks run a long time with a short vibration stimulus. In regard to the tactile sense, there is confusion in the mind as to whether the patient is reporting tactile sense or hearing, and for this reason I do not use the low tone, or the high fork, but employ the audiometer for the high pitches. In the middle zone of hearing the forks between 300 and 3,000 double vibrations are the forks which give the most useful results in testing. The measurement is by using a standardized blow. The weight of the forks shown by Dr. Sonnenschein is most desirable. I think that Dr. Sonnenschein's work with the Riverbank Laboratory has given us something we can thank him for and we ought to be grateful to him for persuading us to hold on to the forks.

Dr. C. C. Bunch, Baltimore: I am glad to see one thing in the new forks which is a real drawback in the Bezold-Edelmann forks. I have had graduate students working with a set of forks that I was compelled to use. With some of the larger forks, in order to secure a loud tone, it was necessary to strike the fork with considerable force. The result was that the set screws on some of the forks were bent and broken. To secure repairs was expensive and necessitated cutting the threads with a lathe equipped with gears arranged for metric units. In these new forks the set screw is part of the weight so that it is not possible to break the thumb screw when unskilled people are using the forks. Secondly, the low tone forks, especially the 16, make very faint sounds. I think that we could make the prong larger to get an increased area of vibration. Some of the earlier reports on hearing have been deficient. It has been said that there was a clinical significance in the raising of the low tone limit, but if the low tones were made loud enough they could be heard in many cases. It is a distinct advantage to have a fork light enough that it can be handled with the two fingers and thumb. The Bezold forks are very heavy.

Dr. A. G. Pohlman, Buffalo: I agree with both Dr. Sonnenschein and Dr. MacFarlan. Forks have a useful place in testing. All of my quantitative measurements of bone transmission are made with a bone activating receiver with an oscillometer that fits into the manipulator. It is always difficult to plot the lower frequencies. In regard to overtones, I use the 256 and the 512 double vibrations fork. In regard to pressure, both bone and air sounds are affected by plus and minus pressures in the ear canal. I should like to ask Dr. Sonnenschein if the laboratory has perfected a method of striking a standard blow. A trip device was designed to give the fork a standard period of vibration. This was graded

to activate the fork for two or three intensities by a spreader mechanism, so that the fork would be self-activating. This device was for the Lucae type of fork.

Dr. Robert Sonnenschein: Dr. MacFarlan is, I believe, absolutely correct in his assertion. It is true that a slight amount of rusting will not apparently change the pitch of the fork and it does not make a great deal of difference in testing whether there are 254 or 256 double vibrations. I have always felt that accuracy and uniformity are essential qualities in experimental investigation. We cannot very well compare results unless conditions under which tests are made are uniform. It does not perhaps make so great a difference whether the forks rust or not so far as testing is concerned, but it does make them look unsightly. As for the vibrations of the loose pieces of nickel, even though they may not seriously interfere, why have them if you can avoid them? Another matter is that the renickeling is rather expensive. Our point was simply this: that the Committee of the American Academy of Ophthalmology and Otolaryngology (consisting of Dr. Gill, Dr. Mackenzie, Dr. Dean and myself) has endeavored ever since it was appointed in 1921 to educate otologists, especially in the smaller communities, to make the standard tests in a uniform manner. We tried to get forks at a fairly reasonable price. The method of exciting a fork with a pendulum gives uniform results if the pendulum swings through an arc of 90 degrees, the force of the gravity thus being the same each time. I have used a pleximeter which fell through an arc of 90 degrees but I realize that a pendulum is better in many ways, and I have at times used the one that was presented to me by Dr. MacFarlan. So far as the rubber band placed around the prongs is concerned, this does not materially interfere with the duration of the vibration of the fork, but it does have a desirable effect in cutting out the overtones. So far as tone image is concerned, patients do have a memory of tone and therefore it is much better to approach the individual from a distance in testing with a watch, accumeter, voice or otherwise, and to note at which point he first begins to hear the sound. When a fork vibrates for a very long time, the patient has difficulty in knowing when the sound stops. With the low tones, from 16 to 128 double vibrations, the idea is principally to know what the low limit is. We do not as a rule test the duration of the hearing for these forks. We desire to know the lowest tone at which the patient begins to hear by air conduction. With reference to Dr. Shambaugh's remarks about the Rinne test, it often shortens and makes the test more accurate by simply seeing, as he does, whether hearing by air conduction or bone conduction is the louder. Dr. Fowler presented some studies on this question about three years ago at the meeting of the American Laryngological, Rhinological and Otological Society in an effort to determine the ratio of air to bone conduction. When the fork is held firmly against the mastoid we naturally dampen it considerably and diminish the duration of its vibration. Therefore it is often better to strike the fork and press it against the mastoid, and see if the patient hears it, then hold the prongs near the ear, then replace on the mastoid, then before the ear, and so on, until the patient no longer hears by mastoid; and then note how long he still hears it by air conduction. The Rinne test shows the difference between air and bone conduction, and one should remember that simply stating whether the Rinne test is positive or negative is not sufficient. For instance, there are two forms of the positive Rinne test, that is, that air conduction is longer than bone conduction, as in the normal, but in those cases in which the air conduction is longer than bone but both factors are shorter than the normal, there is usually a lesion of the inner ear. Likewise when we state that a Rinne test is negative, meaning thereby that the bone conduction is longer than the air, we should remember that there are several varieties of this, and therefore it is important to know whether the air and bone conduction are considerably shorter than the normal, even though the bone conduction happens to be longer than the air. In the new forks made of the magnesium alloy, we have the great advantage of the absence of rusting, and owing to the extreme lightness in weight the fingers do not tire after doing a number of tests. Furthermore, at the suggestion of Dr. Bunch, clamps or weights were devised which did not have projecting parts as in

the Edelmann forks. Some criticism has been made of the fact that the lowest fork, C-2 (16 double vibrations), does not produce very loud tones, but Prof. Bentley told me that he was surprised to see what sounds could be obtained from these forks in spite of the noise in the room. In striking these forks, a uniform method should be used.

TRAUMATIC EAR CONDITIONS IN WORKERS UNDER COMPRESSED AIR. DR. HARRIS H. VAIL, Cincinnati.

This article was published in full in the August issue, p. 113.

DISCUSSION

DR. J. G. DWYER, New York: Twenty-two years ago I performed the autopsy in several fatal cases of caisson disease contracted in the Steinway tunnels in New York and found the condition to be that of nitrogen gas in the tissues, the theory being that the cases were due to liberation of nitrogen due to sudden release of pressure, the same principle as release of pressure in a syphon soda bottle.

The present case (described by Dr. Harris) was intensely interesting and along the same lines as Dr. Vail's. The point to be emphasized in this case was the intense vertigo produced in contrast to the slight nystagmus. This would suggest that vertigo and nystagmus do not go hand in hand, as is so often thought.

DR. THOMAS J. HARRIS, New York: This work opens up questions on a subject that deserves to be thoroughly investigated. I hope that Dr. Vail will not stop before he is able to give further reports on the internal ear, which are now lacking. The case referred to by Dr. Dwyer was most interesting. I have never seen a similar one at the Post-Graduate or the Manhattan Eye and Ear Hospitals. Dr. Shambaugh says that such cases can offer interesting data as to what is taking place in the internal ear. The patient was an Irishman, aged 30, newly arrived in this country. The first time he came out of the caisson, he showed marked symptoms of caisson disease. The history was one of intense vertigo, profound deafness and characteristic symptoms of the "bonds." He was subject to spells of weakness in which he fell and almost lost consciousness. By the audiometer there was complete loss of hearing in the other ear. All tests were negative. There was decided lowering of hearing in the other ear. The graph showed a marked drop for the upper tones, 8,192 being lost. The man was given treatment with pilocarpine and improvement of hearing in one ear was noted, but no material benefit was shown in the audiograms. The man was given cold caloric test at 60 degrees and there was no response from either canal. The labyrinth appeared dead. The man was put in the turning chair and there was a most profound reaction. We only turned him twice and the vertigo which followed was so intense that we did not try it again. The nystagmus was very short in either direction. In view of this, can it be possible that we must revise our ideas in relation to the center involved? The conclusion that we arrived at was that the man had suffered from a hemorrhage sufficient to blot out both vestibular and cochlear parts of the labyrinth. In both sides there were probably multiple hemorrhages. I saw the patient in the hospital before I left and he had recovered from his attacks of vertigo; but the interesting point is that from the time he came to the hospital he showed a lowered mental activity. Dr. Dwyer thinks that the mental sluggishness has increased, and that he has reached the point of stupor. We must consider whether or not the involvement is extra-labyrinthine.

DR. G. E. SHAMBAUGH, Chicago: Do you recall any evidence of injury to the middle ear?

DR. THOMAS J. HARRIS: The drums were normal. There was no evidence of injury to the middle ear a few days after the accident.

DR. S. MACCUEN SMITH, Philadelphia: You spoke of the administration of pilocarpine. Was the drug given hypodermically, or by mouth?

DR. THOMAS J. HARRIS: We felt that the man was entitled to any possible form of treatment. The medicine was given by mouth and consisted of a 2 per cent solution of muriate of pilocarpine, the dose being increased 1 minim, night and morning, until profound sweating took place. Whether or not that had any effect on the slight improvement of hearing we do not know. The vertigo was materially improved, almost disappeared, but his mental condition was still impaired. He had to be brought to the hospital by his niece. The two points of interest are the discrepancy between the rotation and the caloric test, and secondly the mental sluggishness. In regard to pilocarpine, Politzer used it in certain cases of labyrinthine involvement, administering it hypodermically. I should like to have Dr. Vail tell us what the medicolegal aspect of these cases is, and whether he has had any experience with this question.

DR. S. MACCUEN SMITH: It was Politzer who first suggested hypodermic injections of pilocarpine for the treatment for certain labyrinthine diseases. In my experience this line of treatment has been beneficial in a fair number of cases, especially if its administration has been followed by iodine given internally in quickly ascending doses until the physiologic effects have been produced, such as a mild coryza.

DR. F. T. HILL, Waterville, Mo.: In 1915, during a period of subway construction, we had some cases at the Manhattan Eye and Ear Infirmary. There were definite symptoms of caisson disease. Some patients have also been seen recently from work on the Canadian border. There is a definite lesion of the middle ear without labyrinthine involvement. In one case there was a mucoid discharge from the nose and hemorrhage from one ear. Sinus infection would be indicated by the discharge from the nose. The condition in this case quieted down rapidly after incision of the membrana tympani, but the patient was sent back into the caisson before the ears were healed. The hearing was very low on the audiometer. I feel that in a case of this kind it should be insisted on that the man does not go back under compressed air until the lesions of the ears are completely healed.

DR. GEORGE E. SHAMBAUGH, Chicago: This unusually interesting communication by Dr. Vail has shown the outstanding feature in regard to the involvement of the ear in caisson disease: (1) There is failure to get a proper equalization of pressure on both sides of the drum membrane, and (2) there is liberation of gas emboli into the circulation with possibility of their lodging in the labyrinthine vessels. In the first case also we may get labyrinthine involvement. This may be common in connection with rupture and injury of the drum membrane. It would be interesting to find out whether increase of the pressure or the liberation of the patient from the pressure is what causes the injury. Both processes might result in traumatism. The patient will recover from a simple tear in the drum membrane, but if there is hemorrhage into the internal ear there will be Ménière's syndrome, with permanent deafness and tinnitus. In regard to the air emboli, I know a case in which a man was in the habit of loosening up the septal membranes by air pressure. In one case the patient developed Ménière's syndrome and the hearing was destroyed in one ear.

I hope that the studies made in this disease will add to the acquisition of knowledge of the physiology of the internal ear. If the facts are kept clearly in mind we may get some interesting sidelights on the function of the internal ear. The labyrinthine artery is a single vessel and if that is plugged all function of the labyrinth is destroyed. On the other hand, minute gas emboli need not block up the whole labyrinthine vessel. The first branch supplies the proximal two thirds of the basal coil and also part of the ampulla. If the lesion is located here the high tones should be lost by audiometer tests. We know how far the artery extends, and a lesion of the basal coil should produce disturbance of tones and also upset the function of the posterior semicircular canal. That might tell something of the function of the posterior semicircular canal. The second branch supplies a definite area; the macule of the saccule; the macule of the utricle, and the ampulla of the posterior and superior semicircular canals. In questions in

which we can exclude involvement of the middle ear we may be able to differentiate between labyrinthine and cochlear involvement. According to the involvement of the vessels of the modiolus, the apex of the cochlea may remain intact. The vessels of the modiolus are in the nature of end-arteries and do not communicate with adjacent blood vessels except by minute branches under the tunnel of Corti. The vessels running along the lamina spiralis ossea supply Corti's organ, and their occlusion would produce a lesion of the organ of Corti. Study of these cases should give insight into the physiology of the organ of Corti.

DR. J. GORDON WILSON, Chicago: When you did the caloric test, did you put the head back; in other words, was it done on both the superior and the horizontal canals?

DR. THOMAS J. HARRIS, New York: That question was asked of Dr. Dwyer at the meeting at the Academy of Medicine. The caloric test was done in the various positions.

DR. ROBERT SONNENSCHEIN, Chicago: I should like to ask how it is that if there was no reaction to the caloric test with the head in the various positions, there nevertheless was found to be some response of the canals on turning, and this response was equal in the two directions. If the caloric response was gone, how can one explain this phenomenon?

DR. T. J. HARRIS: We did not know how to reconcile the discrepancies. The chief thing was the profound vertigo. It looked as if we would have to revise our views as to the mechanism of nystagmus. We hope to make a further report on this case later on.

DR. J. GORDON WILSON: We are not justified in saying that all vertigo is of aural or even vestibular origin. The profound vertigo to which Dr. Harris refers does not astonish me. The patient showed a markedly affected mentality, and it is characteristic of cerebral disturbances that they give pronounced vertigo. This can be often seen in neurasthenic patients complaining of dizziness. The explanation appears to me to be that in such cases a cerebral influence is lacking preventing the normal inhibitory influence from the cerebrum.

DR. ROBERT SONNENSCHEIN: Alexander would not coincide in that view of nystagmus.

DR. J. GORDON WILSON: You can get vertigo without nystagmus. It is well exemplified in the dizziness that some people experience on looking down from a height.

DR. H. H. VAIL: The discussion has done what I hoped it would do, namely, to bring out the important aspects of a problem that is a growing one. Undoubtedly there will be many works of construction, and this condition will recur in the future. I am glad that Dr. Shambaugh said what he did. There is no report made of examination of the internal ears, and no microscopic study made of the ears or temporal bones in the cases autopsied. That should make us watch for these cases and go after an autopsy. Until you have a final proof you do not know what happened. Dr. Dwyer's case was an interesting one, but there are many similar cases reported in the literature. A man was made deaf, blind and speechless by caisson disease. I believe that the only treatment is prompt recompression as soon as symptoms appear. The laws of New York State specify the length of time a man can work under pressure, and give regulations as to decompression and recompression. It is foolish to take patients to the hospital unless there is a recompression tank there. The time to beat the case is when the symptoms first appear. Recovery may then take place as the bubbles of nitrogen are recompressed back into a soluble condition. There is a definite legal aspect to this problem, because most of them are industrial cases. New York State has a definite code and most other states are furnished with New York laws in construction cases, but I think that the construction companies are often cold-blooded, and do not insist on otologic examinations. They should be forced to provide these for the workmen whenever necessary. Otologists should be readily available because the lesions of the ears in caisson workers are serious. The

ear troubles in the two cases I have reported are due to compressed air, and are probably not due to nitrogen bubbles. In regard to Dr. Shambaugh's remark about the elevation of the septal mucosa by compressed air in performing submucous resection of the septum, with formation of an embolus, that is entirely different from the embolus in caisson disease. This forms in the spaces in which circulation is poor, such as the spine and joints. The brain usually escapes. Dr. Dwyer's case is one of cerebral damage. Sometimes the brain and cerebellum escape, but the spinal cord does not. Often these workmen get into this difficulty from inexperience. In France an aviator came down too quickly and bled from the ears. A few days later mastoid tenderness developed and a mastoid operation was done. The middle ear and mastoid were filled with blood, caused by hemorrhage when the patient passed too rapidly from the lower to the higher pressure.

Directory of Otolaryngologic and Ophthalmologic Societies *

NATIONAL

American Medical Association, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Robert C. Lynch, Maison Blanche Bldg., New Orleans, La.
Secretary: Dr. Gabriel Tucker, Bronchoscopic Clinic, University Hospital, Philadelphia.
Place: Detroit. Time: June 23-27, 1930.

American Bronchoscopic Society

President: Dr. Thomas E. Carmody, Metropolitan Bldg., Denver.
Secretary-Treasurer: Dr. Louis H. Clerf, 128 S. 10th St., Philadelphia.

American Laryngological Association

President: Dr. Lewis A. Coffin, New York.
Secretary: Dr. George M. Coates, 1721 Pine St., Philadelphia.

American Laryngological, Rhinological and Otological Society

President: Dr. Ross Hall Skillern, 1811 Spruce St., Philadelphia.
Secretary: Dr. R. L. Loughran, 33 E. 63d St., New York.
Place: Atlantic City, N. J. Time: May, 1930.

American Otological Society

President: Dr. S. MacCuen Smith, 1429 Spruce St., Philadelphia.
Secretary: Dr. Thomas J. Harris, 104 E. 40th St., New York.

American Academy of Ophthalmology and Oto-Laryngology

President: Dr. William H. Wilder, 122 S. Michigan Ave., Chicago.
President-Elect: Dr. J. F. Barnhill, Miami Beach, Fla.
Executive Secretary: Dr. William P. Wherry, Medical Arts Bldg., Omaha.
Place: Chicago. Time: October, 1930.

LOCAL

Los Angeles County Medical Society, Section of Ophthalmology and Otolaryngology

President: Dr. Harold S. Muckleston, 6422 Hollywood Blvd., Los Angeles.
Secretary-Treasurer: Dr. J. Frank Friesen, 1208 Roosevelt Bldg., Los Angeles.
Place: California Hospital, assembly room. Time: 8 p. m., first Monday of each month.

The Colorado Oto-Laryngological Society

President: Dr. Frank L. Dennis, Ferguson Bldg., Colorado Springs.
Secretary: Dr. Rex L. Murphy, Metropolitan Bldg., Denver.
Place: Assembly Room of Metropolitan Bldg., Time: First Saturday of each month from October to May.

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* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

Medical Society of the District of Columbia, Section on Ophthalmology and Oto-Laryngology

Chairman: Dr. Louis S. Greene, 1710 Rhode Island Ave. N. W., Washington.
Secretary: Dr. E. R. Gookin, Medical Science Bldg., Washington.
Place: 1718 M St. N. W. Time: 8 p. m., third Friday of each month.

Atlanta Academy of Ophthalmology and Otolaryngology

President: Dr. H. F. McDuffie, 45 Edgewood Ave., Atlanta, Ga.
Secretary: Dr. Leon E. Brawner, 157 Forrest Ave. N. E., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St. N. E. Time: 8 p. m., last Thursday of each month.

Eye, Ear, Nose and Throat Club of Georgia

President: Dr. George B. Smith, Rome.
Secretary-Treasurer: Dr. William O. Martin, Jr., 384 Peachtree St., Atlanta.

Chicago Laryngological and Otological Society

President: Dr. Samuel Salinger, 25 E. Washington St., Chicago.
Secretary-Treasurer: Dr. Austin A. Hayden, 25 E. Washington St., Chicago.
Place: Medical and Dental Arts Bldg., 185 N. Wabash Ave. Time: 6 p. m., first Monday of each month from October to May.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. A. Van Osdol, 320 N. Meridian St., Indianapolis.
Secretary: Dr. Robert J. Masters, 23 E. Ohio St., Indianapolis.
Place: Indianapolis. Time: December 10 and 11, 1930.

Indianapolis Ophthalmological and Oto-Laryngological Society

President: Dr. Robert J. Masters, Hume-Mansur Bldg., Indianapolis.
Secretary: Dr. Kenneth L. Craft, Hume-Mansur Bldg., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

New Orleans Ophthalmological and Otological Society

President: Dr. William A. Wagner, Pere Marquette Bldg., New Orleans.
Secretary-Treasurer: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: January to June and October to January—third Thursday of each month.

Baltimore City Medical Society, Section on Otology and Laryngology

Chairman: Dr. Waitman F. Zinn, Medical Arts Bldg., Baltimore.
Secretary: Dr. Moses L. Breitstein, 1212 Eutaw Pl., Baltimore.
Place: 1211 Cathedral St. Time: 8:30 p. m., last Friday of each month.

New England Otological and Laryngological Society

President: Dr. Harris P. Mosher, 828 Beacon St., Boston.
Secretary-Treasurer: Dr. Charles T. Porter, 520 Commonwealth Ave., Boston.

Detroit Oto-Laryngological Society

President: Dr. C. C. McClelland, David Whitney Bldg., Detroit.
Secretary-Treasurer: Dr. Don A. Cohoe, 13535 Woodward Ave., Detroit.
Place: Maccabees Bldg. Time: Third Wednesday evening of each month from October to May.

The Minnesota Academy of Ophthalmology and Oto-Laryngology

President: Dr. C. N. Spratt, 900 Nicollet Ave., Minneapolis.
Secretary-Treasurer: Dr. J. H. Morse, 80 S. 7th St., Minneapolis.

Kansas City Society of Ophthalmology and Otolaryngology

President: Dr. L. R. Forgrave, Logan Bldg., St. Joseph, Mo.
Secretary: Dr. A. E. Eubank, Argyle Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

St. Louis Ear, Nose and Throat Club

Acting President: Senior member of the executive committee: Dr. F. C. Simon, Arcade Bldg., St. Louis, Mo.
Secretary: Dr. M. L. Hanson, Murphy Bldg., East St. Louis, Ill.
Place: University Club Bldg. Time: Third Wednesday in February, April, October and December.

Omaha and Council Bluffs Ophthalmological and Otolaryngological Society

President: Dr. Charles M. Swab, Medical Arts Bldg., Omaha.
Secretary-Treasurer: Dr. J. C. Davis, 1615 Howard St., Omaha.
Place: Medical Arts Tea Room. Time: 5:15 and 7 p. m., third Wednesday of each month from October to May.

Academy of Medicine of Northern New Jersey, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Frederick J. Wort, 1080 Broad St., Newark.
Secretary: Dr. Earl LeRoy Wood, 31 Lincoln Park, Newark.
Place: 91 Lincoln Park South. Time: 8:45 p. m., second Monday of each month.

New York Academy of Medicine, Section of Laryngology and Rhinology

Chairman: Dr. Mervin C. Myerson, 12 E. 86th St., New York.
Secretary: Dr. John M. Loré, 240 West End Ave., New York.
Place: 103d St. and 5th Ave. Time: 8:30 p. m., fourth Wednesday of each month from October to May.

New York Academy of Medicine, Section of Otology

Chairman: Dr. Clarence H. Smith, 2 E. 54th St., New York.
Secretary: Dr. James Garfield Dwyer, 57 W. 57th St., New York.
Place: 103d St. and 5th Ave. Time: Second Friday of each month from October to May.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. John P. O'Keefe, 251 State St., Albany.
Secretary-Treasurer: Dr. Arthur F. Holding, 142 Washington Ave., Albany.
Time: Third Wednesday of October, November, March, April, May and June.

Rochester Eye, Ear, Nose and Throat Society

Chairman: Dr. A. Vincent Walker, 833 South Ave., Rochester, N. Y.
Secretary-Treasurer: Dr. John F. Gipner, 53 Fitzhugh St., Rochester, N. Y.
Place: Rochester Medical Association, 13 Prince St. Time: 8 p. m., third Monday of each month from October to May.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. George H. Rockwell, Physicians Bldg., Syracuse, N. Y.
Secretary-Treasurer: Dr. A. Harry Rubenstein, Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.

NORTH DAKOTA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. George M. Constans, Bismarck.
Secretary-Treasurer: Dr. F. L. Wicks, Valley City.

CINCINNATI OTO-LARYNGOLOGICAL SOCIETY

President: Dr. Harris H. Vail, 24 E. 8th St., Cincinnati.
President-Elect: Dr. Edward King, Pearl Market Bank Bldg., Cincinnati.
Secretary-Treasurer: Dr. Donald Lyle, 19 W. 7th St., Cincinnati.
Place: University Club. Time: 6:45 p. m., second Tuesday of each month from October to May.

CLEVELAND ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. M. Paul Motto, Rose Bldg., Cleveland.
Secretary: Dr. A. D. Ruedemans, Euclid and E. 93d St., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY

President: Dr. Arthur C. Jones, 105 N. 8th St., Boise, Idaho.
Secretary-Treasurer: Dr. Walter F. Hoffman, 817 Summit Ave., Seattle.

PHILADELPHIA LARYNGOLOGICAL SOCIETY

President: Dr. Henry A. Laessle, 13th and Spruce Sts., Philadelphia.
Secretary: Dr. Herman B. Cohen, 13th and Spruce Sts., Philadelphia.
Place: College of Physicians. Time: 8:30 p. m., first Tuesday of each month from October to June.

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OTOLOGY AND LARYNGOLOGY

Chairman: Dr. Maxwell Landon, 1530 Locust St., Philadelphia.
Clerk: Dr. Frederick M. Strouse, 13th and Spruce Sts., Philadelphia.
Place: College of Physicians. Time: 8:30 p. m., third Wednesday of each month from October to June.

PITTSBURGH OTOLOGICAL SOCIETY

Chairman: Dr. John R. Simpson, 115 South Highland Ave., Pittsburgh.
Secretary-Treasurer: Dr. Watson Marshall, 121 University Place, Pittsburgh.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

President: Dr. J. E. Raia, 272 Broadway, Providence.
Secretary: Dr. F. W. Dimmitt, Jr., 195 Thayer St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. Fred Hasty, 119 Seventh Ave., Nashville, Tenn.
Secretary: Dr. Fletcher D. Woodward, Box 162, University, Va.
Place: Louisville, Ky. Time: November, 1930.

THE MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. R. J. Warner, 706 Church St., Nashville.
Secretary-Treasurer: Dr. W. W. Wilkerson, Jr., Bennie-Dillon Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month.

Dallas Academy of Ophthalmology and Otolaryngology

President: Dr. D. L. Bettison, Medical Arts Bldg., Dallas, Texas.
Executive Secretary: Dr. W. Mood Knowles, Medical Arts Bldg., Dallas, Texas.
Recording Secretary: Dr. L. A. Nelson, 4105 Live Oak, Dallas, Texas.
Place: Dallas Athletic Club. Time: 6 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. W. R. Thompson, 510 Main St., Fort Worth, Texas.
Secretary-Treasurer: Dr. R. H. Needham, Fort Worth National Bank Bldg., Fort Worth, Texas.
Place: University Club. Time: 6:30 p. m., first Friday of each month except July and August.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. John H. Foster, 1300 Walker Ave., Houston, Texas.
Secretary: Dr. Edward W. Griffey, Houston Clinic, Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., first Thursday of each month from September to June.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. F. W. Sorrell, Gibbs Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. A. F. Clark, 728 Main Street, San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

Utah Ophthalmological Society

President: Dr. F. M. McHugh, 17 Exchange Pl., Salt Lake City.
Secretary-Treasurer: Dr. W. Leroy Smith, Ezra Thompson Bldg., Salt Lake City.

Virginia Society of Otolaryngology and Ophthalmology

President: Dr. H. B. Stone, 303 First St., Roanoke.
Secretary-Treasurer: Dr. Fletcher D. Woodward, Box 162, University.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. Will Otto Bell, Medical-Dental Bldg., Seattle.
Secretary-Treasurer: Dr. Francis A. Brugman, Medical-Dental Bldg., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

Spokane Academy of Ophthalmology and Otolaryngology

President: Dr. O. M. Rott, Paulsen Bldg., Spokane, Wash.
Secretary: Dr. C. A. Veasey, Jr., 421 Riverside Ave., Spokane, Wash.

The Milwaukee Oto-Ophthalmic Society

President: Dr. L. P. Allen, 145½ Main St., Oshkosh, Wis.
Secretary-Treasurer: Dr. Edward R. Ryan, 425 E. Water St., Milwaukee.
Place: University Club. Time: 6:30 p. m., third Tuesday of each month.

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Manuscripts for publication, books for review, and correspondence relating to the editorial management should be sent to Dr. George E. Shambaugh, Editor-in-Chief, 122 South Michigan Avenue, Chicago, or to any other member of the Editorial board. Communications regarding subscriptions, reprints, etc., should be addressed, ARCHIVES OF OTOLARYNGOLOGY, American Medical Association, 535 North Dearborn Street, Chicago.

Articles are accepted for publication on condition that they are contributed solely to the ARCHIVES OF OTOLARYNGOLOGY. Manuscripts must be typewritten, preferably double spaced, and the original copy should be submitted. Zinc etchings and halftones of illustrations will be supplied by the publisher when the original illustrations warrant.

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